Q1'09 USB 3.0 Errata (Released 05/15/2009)

Ref	Section/ Table	Page	From	To	Comment	Disposition
2.001				Steam Endpoint - A Steam Endpoint is a SuperSpeed Bulk endpoint whose SuperSpeed Endpoint Companion Descriptor bmAtttributes field declares a MaxStreams value that is greater than 0.	Clarification (Add definition of Stream Endpoint)	
					Clarification	
4.001	4.4.4	4-7	The affect of this behavior could have a significant impact on overall performance.	The effect of this behavior could have a significant impact on overall performance.	Editorial	
4.002	4.4.7.2 4.4.8.2	4-13 4-15	Periodic endpoints may be allocated up to 80% of the total available bandwidth on SuperSpeed.	Periodic endpoints may be allocated up to 90% of the total available bandwidth on SuperSpeed.	To match with the amount of bandwidth a USB 3.0 ISO endpoint can really consume	

5.001	5.3.4.2 Table 5-6	5-34	(Pin 6&7) MicA_SS**TX**-/+ SuperSpeed **transmitter** differential pair	MicA_SS**RX**-/+ SuperSpeed **receiver** differential pair	Correct typo (TX should be RX)	
5.002	5.3.4.2 Table 5-6	5-34	(Pin 9&10) MicA_SS**RX**-/+ SuperSpeed **receiver** differential pair	MicA_SS**TX**-/+ SuperSpeed **transmitter** differential pair	Typo (RX should be TX)	

5.003	5.6.1.3	4-48	"To be consistent with the USB 3.0 channel nominal differential characteristic impedance requirement of 90 Ω, all measured differential S-parameters shall be normalized with a 90-Ω reference differential impedance. Most VNA measurement software allows normalization of measured S-parameters to a different reference impedance. For example in PLTS, one can set the port impedance to 45 Ω to normalize the measured 50-Ω single-ended S-parameters to 45 Ω; this will result in a 90-Ω differential S-parameters after the singled-ended-to-differential conversion."	Remove this paragraph.	Simplification, the renormalization is found not necessary.	
5.004	5.6.1.3.1	5-49	"…, which is normalized with a 90-Ω differential impedance and is defined with the following vertices: …"	"…, which is defined with the following vertices: …"	Simplification	

5.005	5.6.1.3.2	5-50	"…, referencing to a 90-Ω differential impedance."	Remove "referencing to a 90-Ω differential impedance"	Simplification	
5.006	5.6.1.3.3	5-51	"… The reference differential impedance shall be 90 Ω. …"	Remove "The reference differential impedance shall be 90 Ω."	Simplification	

6.001	6.3	6-5	Figure 6-5, replace MSB and LSB	Figure 6-5 (U-017), replace MSb and LSb	Typo	
6.002	6.4.4	6-12	Entry to the Polling.Compliance substate is described in Chapter 7. This initiates the transmission of the pseudo-random data pattern generated by the scrambled D10.0 compliance sequence.	Entry to the Compliance Mode is described in Chapter 7. This initiates the transmission of the pseudo-random data pattern generated by the scrambled D0.0 compliance sequence.	Typos	
6.003	6.4.3	6-11	• The SKP Ordered Set shall consist of a SKP K-Symbol followed by a SKP K-Symbol. A SKP Ordered Set represents two Symbols that can be used for clock compensation. Error detection and recovery from a corrupted SKP Symbol is described in Section 6.4.2.13.	• The SKP Ordered Set shall consist of a SKP K-Symbol followed by a SKP K-Symbol. A SKP Ordered Set represents two Symbols that can be used for clock compensation.	Editorial	
6.004	6.4.4	6-12	Upon detection of a reset, LFPS the compliance pattern shall be terminated.	Upon detection of a reset, the compliance pattern shall be terminated.	Editorial	

6.005	6.10.1	6-35	All signal and power pins must withstand 2000 V of ESD using the human body model and 500 V using the charged device model without damage (Class 2 per JEDEC JESE22-A114-A).	All signal and power pins must withstand 2000 V of ESD using the human body model (CLASS 2 per JEDEC JESD22-A114F) and 500 V using the charged device model (CLASS III per JEDEC JESD22-C101D) without damage.	Incorrect reference	

7.001	7.2.4.1.6	7-20	"sDataSymbolsBabble"	sDataSymbolsBabble	Editorial	
7.002	7-12	7-36	Notes: 1: Upon Polling timeout, a port shall transition to different states. Refer to Section 7.5.4.3 for details. 2: The accuracy of U2 inactivity timer is specified in Section 10.4.1.	Notes: 1. Upon Polling timeout, a port shall transition to different states. Refer to Section 7.5.4.3 for details. 2. The accuracy of U2 inactivity timer is specified in Section 10.4.1.	Editorial (change colon after 1 to period)	
7.003	7.5.4.6.1/ 7.5.10.3.2/ 7.5.10.4.1	7-45/ 7-53/ 7-54	TS2 Ordered set	TS2 ordered set	Editorial	
7.004	7.5.8.2	7-51	$Z^{RX\text{-}HIGH\text{-}IMP\text{-}DC\text{-}POS}$	$Z_{RX\text{-}HIGH\text{-}IMP\text{-}DC\text{-}POS}$	Editorial	
7.005	7.5.9.2	7-52	ZRX-HIGH-IMP-DC-POS	$Z_{RX\text{-}HIGH\text{-}IMP\text{-}DC\text{-}POS}$	Editorial	
7.006	7.3.10	7-32	Receiving an expected header packet during link initialization.	Receiving an unexpected header packet during link initialization.	Typo	

7.007	7.2.4.2.1	7-23	A port accepting the request to enter a low power link state shall disable and reset the PM_ENTRY_TIMER upon receipt of an LPMA, a TS1 ordered set, or an LFPS meeting U1 or U2 exit, or U3 wakeup signaling specified in Section 6.9.2.	A port accepting the request to enter a low power link state shall disable and reset the PM_ENTRY_TIMER upon receipt of an LPMA, or a TS1 ordered set.	Remove an obsolete condition.	
7.008	7.5.10.4.2	7-54	• The port shall transition to SS.Inactive when the following conditions are met. 1. Either the Ux_EXIT_TIMER or the 6 ms timer times out. 2. The conditions to transition to Recovery.Idle are not met. 3. For a downstream port, the transition to Recovery is not to attempt a Hot Reset.	• The port shall transition to SS.Inactive when the following conditions are met. 1. Either the Ux_EXIT_TIMER or the 6 ms timer times out. 2. For a downstream port, the transition to Recovery is not to attempt a Hot Reset.	Consistent with the transition condition to Rx.Detect.	
7.009	Table 7-12	7-36	U0 – RxDetect – 1 ms	U0 – Recovery – 1 ms	Typo	

7.010	7.5.6	7-49	Note: After entry to U0, both ports are required to exchange port capabilities information using LMP within tPortConfiguration time as defined in Section 8.4.5	Note: After entry to U0, both ports are required to exchange port capabilities information using LMP within tPortConfiguration time as defined in Section 8.4.5. This includes the following scenarios. 1. Entry to U0 from polling directly; 2. Entry to U0 indirectly from Polling through Hot Reset; 3. Entry to U0 from Recovery and port configuration has never been successfully exchanged after exiting from Polling.	Clarification on LMP.	

7.011	7.5.12.3.1	7-58	• Upon entry to this substate, the port shall first transmit at least 16 TS2 ordered sets continuously with the Reset bit asserted. Note: Depending on the time delay between the two ports entering Hot Reset, when the downstream port is transmitting the first 16 TS2 ordered sets with the Reset bit asserted, it may still receive part of the TS2 ordered sets from the upstream port exiting from Polling.Configuration or Recovery.Configuration. The downstream port shall ignore those TS2 ordered sets.	• Upon entry to this substate, the port shall first transmit at least 16 TS2 ordered sets continuously with the Reset bit asserted. Note: Depending on the time delay between the two ports entering Hot Reset, when the downstream port is transmitting the first 16 TS2 ordered sets with the Reset bit asserted, it may still receive part of the TS2 ordered sets from the upstream port exiting from Polling.Configuration or Recovery.Configuration. The downstream port shall ignore those TS2 ordered sets. Also upon entry to this substate, both ports shall ignore the Disabling Scrambling bit in the link configuration field of the TS2 Ordered Set. This bit is only decoded in Polling.Idle or Recovery.Idle.	clarification	

7.012	7.4.2	7-34	• If the downstream port is in U1 or U2, it shall exit U1 or U2 using the LFPS exit handshake, transition to Recovery and then transition to Hot Reset. • If a downstream port is in a transitory state of Polling or Recovery, it shall use Hot Reset. • If a Hot Reset fails due to a LFPS handshake timeout, a downstream port shall transition to SS.Inactive until software intervention or upon detection of removal of an upstream port. • If a Hot Reset fails due to a TS1/TS2 handshake timeout, a downstream port shall transition to Rx.Detect and attempt a Warm Reset.	• If a downstream port is in a transitory state of Polling or Recovery, it shall use Hot Reset. • If the downstream port is in U1 or U2, it shall exit U1 or U2 using the LFPS exit handshake, transition to Recovery and then transition to Hot Reset. The following two additional rules apply when the downstream port fails to enter Hot Reset. 1. If a Hot Reset fails due to a LFPS handshake timeout in U1 or U2, a downstream port shall transition to SS.Inactive until software intervention or upon detection of removal of an upstream port. 2. If a Hot Reset fails due to a TS1/TS2 handshake timeout in Recovery, a downstream port shall transition to Rx.Detect and attempt a Warm Reset.	Clarification	3/19/09

7.013	7.2.4.1	7-17	1. A port shall initiate the Rx Header Buffer Credit Advertisement upon completion of the Header Sequence Number Advertisement.	1. A port shall initiate the Rx Header Buffer Credit Advertisement after sending LGOOD_n during Header Sequence Number Advertisement.	Clarification	
7.014	7.4.2	7-34	The LTSSM of a port shall transition to U0	The LTSSM of a port shall transition to U0 through RxDetect and Polling.	Clarification	

8.001	8.4.5	8-8	All ports shall send this LMP within tPortConfiguration time after completion of link initialization (refer to Section 7.3.4.1.1).	After the port enters U0 from Polling, the port shall send Port Capability LMP within tPortConfiguration time once link initialization (refer to Section 7.2.4.1.1) is completed. Note the port may not always transition directly from Polling to U0, but may transition through other intermediate states (e.g. Recovery or Hot Reset) before entering U0. Regardless of states passed through between Polling and entry into U0, the device shall send a Port Capability LMP immediately upon entering U0.	Clarification.	Revised on 3/27/09

8.002	Table 8-12	8-13	**Stream ID/Reserved**. If this ACK TP is targeted at a Bulk endpoint, this field contains a **Stream ID** value between 1 and 65535. The **Stream ID** value of 0 is reserved for Stream pipes. The usage of this field is class dependent. This field shall be set to zero if the Bulk endpoint does not support Streams.	**Stream ID/Reserved.** If this ACK TP is targeted at a Bulk endpoint that supports Streams (i.e. a Stream pipe), this field contains a Stream ID value between 1 and 65535. The Stream ID value of 0 is reserved for Stream pipes and the TP shall be considered invalid if a 0 value is received. All other pipe types shall treat this field as reserved. The usage of this field is class dependent. This field shall be set to zero if the Bulk endpoint does not support Streams. Refer to section 8.12.1.4 for more information on Stream IDs.	Clarification	

8.003	8.2		All packets consist of a 14-byte header, followed by a 2-byte Link Control Word at the end of the packet (16 bytes total). All headers have two common fields (Revision and Type) that are used by the receiving entity (e.g., host, hub, or device) to determine how to process the packet. All headers include a 2-byte CRC (CRC-16). Packet headers have an uncorrectable or undetectable error rate less than one error in 10_{20} bits.	All packets consist of a 14-byte header, followed by a 2-byte Link Control Word at the end of the packet (16 bytes total). All headers have a Type field that is used by the receiving entity (e.g., host, hub, or device) to determine how to process the packet. All headers include a 2-byte CRC (CRC-16). Packet headers have an uncorrectable or undetectable error rate less than one error in 10_{20} bits.	Only one common field exists. Overlooked when making the change to Section 8.3	
8.004	8.12.1.2 8.12.1.3 8.12.4.1 8.12.4.3	Multiple pages	ClearFeature (STALL)	ClearFeature (ENDPOINT_HALT)	There is no STALL feature selector. It should be ClearFeature(ENDPOINT_HALT)	

8.005	Table 8-33	8-68	Maximum time after a successful warm reset or a power on reset that the ink partners must complete the port configuration process. This includes the time to exchange port capabilities, send the port configuration and receive acknowledgement.	Maximum duration from when the port enters U0 to when it has completed the exchange of LMPs. In case of tiebreaker (refer to Table 8-7), both ports shall reset their timers and restart them for each LMP exchange until the tiebreaker is resolved.	Correction.	
8.006	8.4.2	8-6	Refer to Section 10.4.2.2 and Section 10.4.2.9 for more details.	Refer to Section 10.14.2.2 and Section 10.14.2.10 for more details.	Incorrect cross reference	
8.007	8.12.1.12	8-34	When the host is ready to receive bulk data, it sends an ACK TP to a device indicating the sequence number and number of packets it expects from the device. An interrupt endpoint shall respond as defined in Section 8.11.1.	When the host is ready to receive bulk data, it sends an ACK TP to a device indicating the sequence number and number of packets it expects from the device. A Bulk endpoint shall respond as defined in Section 8.11.1.		

8.008	8.5.7	8-22	A device shall respond to the PING TP by sending a PING_RESPONSE TP (refer to Section 8.5.8) to the host within the tPingResponse time (refer to Table 8-33).	A device shall respond to the PING TP by sending a PING_RESPONSE TP (refer to Section 8.5.8) to the host within the tPingResponse time (refer to Table 8-33). Note that the device shall not validate the EP_NUM and Direction fields and simply copy them to the respective fields in the PING_RESPONSE TP.	Clarification	
8.009	8.10.3	8-28	In the case of an IN transfer, a device shall stop sending DPs after sending a short DP. The host shall respond to the short DP with an ACK TP with the **NumP** field set to zero. The host shall schedule transactions to an endpoint on the device when another transfer is initiated for that endpoint.	In the case of an IN transfer, a device shall stop sending DPs after sending a short DP. The host shall respond to the short DP with an ACK TP with the **NumP** field set to zero unless it has another transfer for the same endpoint in which case it may set the **NumP** filed as mentioned in Section 8.10.2. The host shall schedule transactions to the endpoint on the device when another transfer is initiated for that endpoint.	Clarification	

8.010	8.12.6.1	8-66	For example, if an isochronous OUT endpoint requests a maximum number of packets in a burst of 11 and the host has 11 packets to send to the endpoint during a service interval there are four possible ways the host could perform the transaction: • A single burst of 11 packets • A burst of eight followed by a burst of three • Two bursts of four followed by a burst of three • Five bursts of two followed by a burst of one	For example, if an isochronous IN endpoint requests a maximum number of packets in a burst of 11 and the host has 11 packets to receive from the endpoint during a service interval there are four possible ways the host could perform the transaction: • Request a single burst of 11 packets • Request a burst of eight followed by a burst of three • Request two bursts of four followed by a burst of three • Request five bursts of two followed by a burst of one. Taking the above example a step further, if the isochronous IN endpoint requests a maximum number of packets in a burst of 11 and a Mult of 2 (in essence requesting 3 bursts of 11) and the host has buffer space to receive 33 packets from the endpoint during a service interval, then the host can use any combination of the above mentioned options to transfer the 3 sets of 11 packets to the endpoint.	Clarification and changed the example to an IN instead of an OUT ISO transfer	

8.011				See Large Errata Section at end of doc.	Clarification	
8.012	8.12.6.2	8-66	Table 8-30 lists the possible responses a device may make in response to an ACK TP. An ACK TP is considered to be invalid if it has an incorrect Device Address or the endpoint number and direction does not refer to an endpoint that is part of the current configuration or it does not have the expected sequence number.	Table 8-30 lists the possible responses a device may make in response to an ACK TP. An ACK TP is considered to be invalid if it has an incorrect Device Address or the endpoint number and direction does not refer to an endpoint that is part of the current configuration or it does not have the expected sequence number or it has the deferred bit set in it.		
8.013	8.12.6.4	8-66	Table 8-32 lists the device processing of data from an OUT data packet. A device never returns a TP in response. In Table 8-32, DP Error may be due to one or more of the following: • CRC-32 incorrect • DPP aborted • DPP missing • Data length in the DPH does not match the actual data payload length.	Table 8-32 lists the device processing of data from an OUT data packet. A device never returns a TP in response. In Table 8-32, DP Error may be due to one or more of the following: • CRC-32 incorrect • DPP aborted • DPP missing • Data length in the DPH does not match the actual data payload length. • Deferred bit set in the DPH		

8.014	Table 8-28	8-32	Replace entry in the last row under the "TP Returned by Device" column: Send an ACK TP with the sequence number set to one (thereby indicating that this SETUP DP was received successfully) and the NumP field set to one.	Send an ACK TP with the sequence number set to one (thereby indicating that this SETUP DP was received successfully). The value in the NumP field indicates to the host whether the device wants to flow control the Data/Status stage or not. Refer to Section 8.12.2 for details.		
8.015	8.12.2	8-48	Note that an endpoint may return an ACK TP with the NumP field set to zero in response to a SETUP packet if it wants to flow control the control transfer. A device must send an ERDY to start the Data or Status stage.	Note that if the endpoint successfully received the SETUP packet, it may return an ACK TP with the NumP field set to zero if it wants to flow control the control transfer. A device shall send an ERDY when it is ready to resume the control transfer (either the Data or Status stage).		

8.016	8.10.1	8-27	An IN endpoint shall be considered to be in a flow control condition if it returns one of the following responses to an ACK TP: • Responding with an NRDY TP • Sending a DP with the EOB field set to 1 in the DPH	An IN endpoint shall be considered to be in a flow control condition if it returns one of the following responses to an ACK TP: • Responding with an NRDY TP; note that an endpoint shall wait until it receives an ACK TP for the last DP it transmitted before it can send an NRDY TP • Sending a DP with the EOB field set to 1 in the DPH	Clarification on when an NRDY can be sent	
8.017	Table 8-25	8-39	Add note in next column after the table	Note that an IN endpoint shall wait until it receives an ACK TP for the last DP it transmitted before it can send an STALL TP.	Clarification	

8.018	8.10.2	8-27	The maximum number of packets that can be sent in a burst prior to receiving an acknowledgement is limited to the minimum of the maximum burst size of the endpoint and the value of the NumP field in the last ACK TP received by the endpoint or the host, minus the number of packets that the endpoint or the host has already sent after the packet acknowledged by the last ACK TP.	The maximum number of packets that can be sent in a burst prior to receiving an acknowledgement is limited to the minimum of the maximum burst size (see definition of bMaxBurst in Table 9-20) of the endpoint and the value of the NumP field in the last ACK TP received by the endpoint or the host, minus the number of packets that the endpoint or the host has already sent after the packet acknowledged by the last ACK TP. Note that host may re-initialize the maximum number of DPs that can be sent/received in a burst to the maximum burst size of the endpoint whenever the endpoint is initialized.	Clarification	

8.019	8.11.2 8.11.3	8-30 8-31	A DPH is considered to be invalid if it has an incorrect Device Address or the endpoint number and direction does not refer to an endpoint that is part of the current configuration or it does not have the expected sequence number.	A DPH is considered to be invalid if it has an incorrect Device Address or the endpoint number and direction does not refer to an endpoint that is part of the current configuration or it does not have the expected sequence number or the Data length in the DPH is greater than the endpoint's maximum packet size.	Data length field in the DPH was not being validated.	
8.020	Table 8-12	8-13	**Packets Pending (PP)**. This field can only be set by the Host. If the field is set the host has another packet available for the endpoint identified by the **Endpoint Number and Direction** field. If no endpoints on this device have packets pending, then the device can use this information to aggressively power manage its upstream link, e.g., set the link to a lower power U1 or U2 state.	**Packets Pending (PP)**. This field can only be set by the Host. If the field is set, then the host is ready to receive another DP from this endpoint/Stream. Where the endpoint is identified by the **Endpoint Number** and **Direction** fields, and if this is a Stream endpoint then the Stream is identified by the **Stream ID** field. If this field is cleared, then the host is not ready to receive any more DPs for this Endpoint/Stream. If no endpoints on this device have packets pending, then the device can use this information to aggressively power manage its upstream link, e.g., set the link to a lower power U1 or U2 state.	Clarify the usage of PP for IN/OUT endpoints.	

8.021	Table 8-23	8-24	Add new row to table, Width 1, Offset 2:27	**Packets Pending (PP)**. This field is may only be set by the Host. If this field is set, then the host has one or more DPs available for transmission to this endpoint/Stream. Where the endpoint is identified by the **Endpoint Number** and **Direction** fields, and if this is a Stream endpoint then the Stream is identified by the **Stream ID** field. If the field is cleared, then this is the last DP that the host has available for transmission to the target endpoint/Stream. If no endpoints on this device have packets pending, then the device can use this information to aggressively power manage its upstream link, e.g., set the link to a lower power U1 or U2 state.	Clarify the usage of PP for IN/OUT endpoints.	
8.022	Table 8-33	8-68	tNRDYResponse Time between device reception of the last framing symbol for an ACK TP or a DPP and the first framing symbol of an NRDY response.	tNRDYorSTALLResponse Time between device reception of the last framing symbol for an ACK TP or a DPP or a STATUS TP and the first framing symbol of an NRDY or STALL response	STALL response time was not indicated	

8.023	Table 8-33	8-68	tACKResponse Time between device reception of the last framing symbol for a DPP and the first framing symbol of an ACK response.	tACKResponse Time between device reception of the last framing symbol for a DPP or a STATUS TP and the first framing symbol of an ACK response.	Response time to a STATUS TP was not indicated	
8.024	8.13	8-68	Note that all txxxResponse (e.g., tNRDYResponse) times are all timings that a device shall meet when the device has nothing else to send on its upstream link.	Note that all txxxResponse (e.g., tNRDYResponse) and tMaxBurstInterval times are all timings that a device shall meet when the device has nothing else to send on its upstream link.	Clarification	
8.025	8.10.2	8-28	Add another exception that allows a host to terminate a burst as described in the to text.	- The host may send an ACK TP with the **rty** bit set to one and the **NumP** field set to any value less than the maximum burst that the endpoint is capable of including zero in response to a device sending a DP with a DPP error (See Section 8.11.2)	Simplifies host behavior and avoids periodic traffic from being starved due to another endpoint requesting multiple retries.	
8.026	Table 8-26	8-30	Discard data and send an ACK TP with the **Retry** bit set requesting for one or more DPs with the **Sequence Number** field set to the sequence number of the DP that was corrupted.	Discard data and send an ACK TP with the **Retry** bit set, requesting for zero or more DPs with the **Sequence Number** field set to the sequence number of the DP that was corrupted.	Same as above	

9.001	9.1.1.6	9-6	In order to conserve power, devices automatically enter the Suspended state (one of Suspended Default, Address, or Configured) when they observe that their upstream link is being driven to the U3 state (refer to Section 7.1.4.2.4).	In order to conserve power, devices automatically enter the Suspended state (one of Suspended Default, Address, or Configured) when they observe that their upstream link is being driven to the U3 state (refer to Section 7.2.4.2.4).	Incorrect cross reference	
9.002	Table 9-20		Maximum number of packets = bMaxBurst x (Mult + 1) The maximum value that can be set in this field is 2.	Maximum number of packets = (bMaxBurst + 1) x (Mult + 1) The maximum value that can be set in this field is 2. This field shall be set to zero if the bMaxBurst field is set to zero.	bMaxBurst is zero based. Also clarified valid value for Mult when the bMaxBurst field is set to zero.	

9.003	9.1.2	9-6	When a device is attached to or removed from the USB, the host uses a process known as bus enumeration to identify and manage the device state changes necessary. When a device is attached to a powered port, the following actions are taken:	When a device is attached to or removed from the USB, the host uses a process known as bus enumeration to identify and manage the device state changes necessary. When a device is attached to a powered port, the following actions are taken (note, these actions apply whether the attached device is a peripheral device or hub device):	Clarification: make clear that a hub is a device and follows the same enumeration process as any other device.	
9.004	9-18	9-42	Maximum packet size this endpoint is capable of sending or receiving when this configuration is selected. There are only two legal values for this field. For control endpoints this field shall be set to 512. For bulk endpoint types this field shall be set to 1024.	Maximum packet size this endpoint is capable of sending or receiving when this configuration is selected. For control endpoints this field shall be set to 512. For bulk endpoint types this field shall be set to 1024.	Incorrect to state that there are only two legal values	

9.005	9.1.2	9-17	11. Based on the configuration information and how the device will be used, the host assigns a configuration value to the device. The device is now in the Configured state and all of the endpoints in this configuration have taken on their described characteristics. The device may now draw the amount of VBUS power described in its descriptor for the selected configuration. From the device's point of view, it is now ready for use.	11. Any time after this, the host can set the U1/U2 timeout for the downstream port on which the device is connected using the Set Port Feature (PORT_U1_TIMEOUT/PORT_U2_TIMEOUT). 12. Based on the configuration information and how the device will be used, the host assigns a configuration value to the device. The device is now in the Configured state and all of the endpoints in this configuration have taken on their described characteristics. The device may now draw the amount of VBUS power described in its descriptor for the selected configuration. From the device's point of view, it is now ready for use.	Ideally the U1/U2 timeouts should be set based on the characteristics of the device connected to the port. In addition these values are reset whenever a port is reset, so setting it in the enumeration phase is a good idea.	
9.006	9.6.4	9-38	Table 9-15 shows the standard interface association descriptor.	Table 9-16 shows the standard interface association descriptor.	Incorrect cross reference	

10.001	10.14.1	10-61	Optional requests that are not implemented shall return a STALL in the Data stage or Status stage of the request.	A hub is required to accept all 'Standard' requests without error. A hub shall not respond with a request error to a well-formed SET_ISOC_DELAY request. A hub is not required to retain or process the *delay* value. Optional requests that are not implemented shall return a STALL in the Data stage or Status stage of the request.	Clarification	
10.002	10.14.2.10	10-74	Setting a feature enables that feature or starts a process associated with that feature; see Table 10-7 for the feature selector definitions that apply to a port as a recipient. Status change may not be acknowledged using this request. Features that can be set with this request are: • PORT_RESET • BH_PORT_RESET • PORT_POWER • PORT_U1_TIMEOUT	Setting a feature enables that feature or starts a process associated with that feature; see Table 10-7 for the feature selector definitions that apply to a port as a recipient. Status change may not be acknowledged using this request. Features that can be set with this request are: • PORT_RESET • BH_PORT_RESET • PORT_POWER • PORT_U1_TIMEOUT	Feature left out	

			• PORT_U2_TIMEOUT • PORT_LINK_STATE • PORT_REMOTE_WAKE_MASK	• PORT_U2_TIMEOUT • PORT_LINK_STATE • PORT_REMOTE_WAKE_MASK • FORCE_LINKPM_ACCEPT		
10.003	10.14.2.6.2	10-72	**C_PORT_LINK_STATE** This bit is set to one when the port's link completes a transition from the U3 state to the U0 state as a result of a SetPortFeature(Port_Link_State) request or completes a transition from any of the U-states to SS.Inactive. This bit is not set to one due to transitions from U3 to U0 as a result of remote wakeup signaling received on a downstream facing port. This bit will be cleared by a ClearPortFeature(C_PORT_LINK_STATE) request, or while logical port power is off.	**C_PORT_LINK_STATE** This bit is set to one when the port's link completes a transition from the U3 state to the U0 state as a result of a SetPortFeature(Port_Link_State) request or completes a transition from any of the U-states to SS.Inactive or Loopback state. This bit is not set to one due to transitions from U3 to U0 as a result of remote wakeup signaling received on a downstream facing port. This bit will be cleared by a ClearPortFeature(C_PORT_LINK_STATE) request, or while logical port power is off.	1 state transitions left out that would have required the C_PORT_LINK_STATE to be set	

<table>
<tr>
<td>10.004</td>
<td>10.14.2</td>
<td>10-62</td>
<td>bmRequestType of GetPortErrorCount incorrect in Table 10-5</td>
<td>bmRequestype must be 10100011B</td>
<td>Correction</td>
<td></td>
</tr>
<tr>
<td>10.005</td>
<td>10.14.2.5</td>
<td>10-67</td>
<td>bmRequestType of GetPortErrorCount incorrect in table in this section</td>
<td>bmRequestype must be 10100011B</td>
<td>Correction</td>
<td></td>
</tr>
<tr>
<td>10.006</td>
<td>10.13.1</td>
<td>10-57</td>
<td>BOS Descriptor
<table>
<tr><td>bLength</td><td>5</td></tr>
<tr><td>bDescriptorType</td><td>BOS Descriptor type</td></tr>
<tr><td>wTotalLength</td><td>44</td></tr>
<tr><td>bNumDeviceCaps</td><td>3</td></tr>
</table></td>
<td>BOS Descriptor
<table>
<tr><td>bLength</td><td>5</td></tr>
<tr><td>bDescriptorType</td><td>BOS Descriptor type</td></tr>
<tr><td>wTotalLength</td><td>42</td></tr>
<tr><td>bNumDeviceCaps</td><td>3</td></tr>
</table></td>
<td>Length incorrect as the SS Device Capability is only 10 bytes in length</td>
<td></td>
</tr>
</table>

<table>
<tr>
<td>10.007</td>
<td>10.13.1</td>
<td>10-57</td>
<td>SuperSpeed USB Device Capability
<table>
<tr><td>bLength</td><td>12</td></tr>
<tr><td>bDescriptorType</td><td>DEVICE CAPABILITY Descriptor type</td></tr>
<tr><td>bDevCapabilityType</td><td>3</td></tr>
<tr><td>bmAttributes</td><td>Implementation-dependent</td></tr>
<tr><td>wSpeedsSupported</td><td>12</td></tr>
<tr><td>bFunctionalitySupport</td><td>8</td></tr>
<tr><td>bU1DevExitLat</td><td>Implementation-dependent</td></tr>
<tr><td>wU2DevExitLat</td><td>Implementation-dependent</td></tr>
<tr><td>wReserved</td><td>0</td></tr>
</table></td>
<td>SuperSpeed USB Device Capability
<table>
<tr><td>bLength</td><td>10</td></tr>
<tr><td>bDescriptorType</td><td>DEVICE CAPABILITY Descriptor type</td></tr>
<tr><td>bDevCapabilityType</td><td>3</td></tr>
<tr><td>bmAttributes</td><td>Implementation-dependent</td></tr>
<tr><td>wSpeedsSupported</td><td>12</td></tr>
<tr><td>bFunctionalitySupport</td><td>3</td></tr>
<tr><td>bU1DevExitLat</td><td>Implementation-dependent</td></tr>
<tr><td>wU2DevExitLat</td><td>Implementation-dependent</td></tr>
</table></td>
<td>Incorrect length and the functionality supported needed to be 3 and not 8</td>
<td></td>
</tr>
<tr>
<td>10.008</td>
<td>10.13.1</td>
<td>10-57</td>
<td>USB 2.0 Extension
<table>
<tr><td>bLength</td><td>7</td></tr>
<tr><td>bDescriptorType</td><td>1</td></tr>
<tr><td>bDevCapabilityType</td><td>2</td></tr>
<tr><td>bmAttributes</td><td>2</td></tr>
</table></td>
<td>USB 2.0 Extension
<table>
<tr><td>bLength</td><td>7</td></tr>
<tr><td>bDescriptorType</td><td>DEVICE CAPABILITY Descriptor type</td></tr>
<tr><td>bDevCapabilityType</td><td>2</td></tr>
<tr><td>bmAttributes</td><td>2</td></tr>
</table></td>
<td>Incorrect descriptor type</td>
<td></td>
</tr>
</table>

<table>
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<td>10-57</td>
<td>ContainerID
<table><tr><td>bLength</td><td>20</td></tr><tr><td>bDescriptorType</td><td>1</td></tr><tr><td>bDevCapabilityType</td><td>4</td></tr><tr><td>bReserved</td><td>0</td></tr><tr><td>ContainerID</td><td>Implementation-dependent</td></tr></table></td>
<td>ContainerID
<table><tr><td>bLength</td><td>20</td></tr><tr><td>bDescriptorType</td><td>DEVICE CAPABILITY Descriptor type</td></tr><tr><td>bDevCapabilityType</td><td>4</td></tr><tr><td>bReserved</td><td>0</td></tr><tr><td>ContainerID</td><td>Implementation-dependent</td></tr></table></td>
<td>Incorrect descriptor type</td>
<td></td>
</tr>
<tr>
<td>10.010</td>
<td>10.13.1</td>
<td>10-58</td>
<td>Endpoint Descriptor (for Status Change Endpoint)
<table><tr><td>bLength</td><td>7</td></tr><tr><td>bDescriptorType</td><td>5</td></tr><tr><td>bEndpointAddress</td><td>Implementation-dependent; Bit 7: Direction = In(1)</td></tr><tr><td>bmAttributes</td><td>Transfer Type = Interrupt (19)</td></tr><tr><td>wMaxPacketSize</td><td>2</td></tr><tr><td>bInterval</td><td>255 (Maximum allowable interval)</td></tr></table></td>
<td>Endpoint Descriptor (for Status Change Endpoint)
<table><tr><td>bLength</td><td>7</td></tr><tr><td>bDescriptorType</td><td>5</td></tr><tr><td>bEndpointAddress</td><td>Implementation-dependent; Bit 7: Direction = In(1)</td></tr><tr><td>bmAttributes</td><td>Transfer Type = Interrupt (19)</td></tr><tr><td>wMaxPacketSize</td><td>2</td></tr><tr><td>bInterval</td><td>16 (Maximum allowable interval)</td></tr></table></td>
<td>Max allowable interval field should be set to 16 and not 255</td>
<td></td>
</tr>
</table>

<table>
<tr>
<td>10.011</td>
<td>10.13.1</td>
<td>10-58</td>
<td>Endpoint Companion Descriptor (for Status Change Endpoint)
<table><tr><td>bLength</td><td>6</td></tr><tr><td>bDescriptorType</td><td>48</td></tr><tr><td>bMaxBurst</td><td>0</td></tr><tr><td>bmAttributes</td><td>0</td></tr></table></td>
<td>Endpoint Companion Descriptor (for Status Change Endpoint)
<table><tr><td>bLength</td><td>6</td></tr><tr><td>bDescriptorType</td><td>48</td></tr><tr><td>bMaxBurst</td><td>0</td></tr><tr><td>bmAttributes</td><td>0</td></tr><tr><td>wBytesPerInterval</td><td>2</td></tr></table></td>
<td>Bytes per interval value was missing</td>
<td></td>
</tr>
<tr>
<td>10.012</td>
<td>10.10</td>
<td>10-48</td>
<td>Although a self-powered hub is not required to implement power switching, the hub shall support the Powered-off state for all ports. Additionally, the hub shall implement the PortPwrCtrlMask (all bits set to one) even though the hub has no power switches that can be controlled by the USB system software.</td>
<td>Although a self-powered hub is not required to implement power switching, the hub shall support the Powered-off state for all ports.</td>
<td>PortPwrCtrlMask field does not exist anymore. Cut and Paste error from USB 2.0 days.</td>
<td></td>
</tr>
</table>

10.013	10.10.1	10-48	A hub may implement any number of power and/or over-current gangs. A hub that implements more than one over-current and/or power switching gang shall set both the Logical Power Switching Mode and the Over-current Reporting Mode to indicate that power switching and over-current reporting are on a per port basis (these fields are in *wHubCharacteristics*). Also, all bits in *PortPwrCtrlMask* shall be set to one.	A hub may implement any number of power and/or over-current gangs. A hub that implements more than one over-current and/or power switching gang shall set both the Logical Power Switching Mode and the Over-current Reporting Mode to indicate that power switching and over-current reporting are on a per port basis (these fields are in *wHubCharacteristics*).	PortPwrCtrlMask field does not exist anymore. Cut and Paste error from USB 2.0 days.	

11.001	11-1	11-1	USB 3.0 and USB 2.0 Interoperability, has these entries: USB host port = USB 2.0 USB device capability = USB 3.0 Connected mode = high speed or full speed	USB 3.0 and USB 2.0 Interoperability should have these entries: USB host port = USB 2.0 USB device capability = USB 3.0 Connected mode = high speed, full speed or low speed	USB 3.0 Devices can operate at low speed when connected to a USB 2.0 host	

C.001	C.2.2.1, under Figure C-6		Once the Link2 partners are in U0, the host sends its packet targeting Dev2 over Link2 where it then is routed to Link3. This incurs the latency associated with the Hub having to parse the packet header to determine the target downstream port for the packet. This latency is characterized by the hub parameter ***HHDL***.	Once the Link2 partners are in U0, the host schedules the packet targeting Dev2. After a Host Scheduling Delay (HSD) the packet is then sent over Link2 where it then is routed to Link3. This routing incurs the latency associated with the Hub having to parse the packet header to determine the target downstream port for the packet. This latency is characterized by the hub parameter ***HHDL***.	Clarification	
C.002	C.2.2.2, under Figure C-7, within the U1 section		After a latency of ***tPort2PortU1EL***, the time it takes the hub to determine that one of its downstream ports is awakening, the hub then begins signaling LFPS on Link2 to initiate transition of the Link2 partners (hub's upstream port and host controller root port RP2) to U0.	After a latency of ***tHubPort2PortU1EL***, the time it takes the hub to determine that one of its downstream ports is awakening, the hub then begins signaling LFPS on Link2 to initiate transition of the Link2 partners (hub's upstream port and host controller root port RP2) to U0.	Typo	

C.003	C.2.2.2, under Figure C-7, within the U2 section		After a latency of ***tPort2PortU2EL***, the time it takes the hub to determine that one of its downstream ports is awakening, the hub then begins signaling LFPS on Link2 to initiate transition of the Link2 partners (hub's upstream port and host controller root port RP2) to U0.	After a latency of ***tHubPort2PortU2EL***, the time it takes the hub to determine that one of its downstream ports is awakening, the hub then begins signaling LFPS on Link2 to initiate transition of the Link2 partners (hub's upstream port and host controller root port RP2) to U0.	Typo	

Large Errata Section

This section is reserved for errata and clarifications that are larger in scope and as such do not fit well into the table format used above.

Errata #8.011 – Clarification to the Streams Section

Summary of the clarification:

- Splits the state machines to describe the actions at the host and device ends of a Stream connection separately
- Clarifies the text for how Stream IDs are communicated between the host and the device and how Prime Pipe transitions are managed by the device
- Adds text and updates figures to cover possible race conditions that may occur between host and device instances of the Stream state machines.

(a). Add Text and location: Section 8.12.1.4, Insert before 2nd paragraph (Note: As…) on Page 8-38

Note: Device Class defined methods are used for coordinating the Stream IDs that are used by the host to select Endpoint Buffers and by the device to select the Function Data associated with a particular Stream. Typically this is done via an out-of-band mechanism (e.g., another endpoint) that is used to pass the list of “Active Stream IDs” between the host and the device.

Note The Stream state machines illustrate a 1:1 relationship between sending a DP and receiving an ACK. Logically this is true, however SuperSpeed burst capabilities allows up to MaxBurst outstanding ACKs between the host and a device so temporally there may be a “many to 1” relationship. Bursts are managed on a Stream pipe identically to how they are managed on a normal Bulk pipe. Refer to section 8.10.2 for more information on Burst Transactions.

(b). From Text and location: Section 8.12.1.4, on Page 8-38

Prime Pipe – This state is always initiated by host, and informs a device that an Endpoint Buffer set has been added or modified by software.

To Text:

Prime Pipe – A transition to this state is always initiated by host, and informs a device that an Endpoint Buffer set has been added or modified by software. After exiting this state, any Active Stream IDs previously considered Not Ready by the device shall now be considered Ready.

Note: To minimize bus transactions, the host controller limits transitions to the **Prime Pipe** state to one transition per **Idle** state entry. This means that while in the **Idle** state only a single transition to the **Prime Pipe** state will be generated even if Endpoint Buffers for multiple streams become ready. And since the **Prime Pipe** state does not specify which Stream(s) are ready, all Active Stream IDs are set to Ready by a **Prime Pipe**. The device is responsible for testing all Active Stream IDs (as described above) by sending the appropriate ERDYs after returning to **Idle**. Note that Device Class defined constraints may be used to limit the number of Active Stream IDs that need to be tested at any point in time.

Idle – A transition to this state indicates that there is no Current Stream (CStream) selected. In this state, the SPSM is waiting for a transition to **Prime Pipe** or **Move Data** initiated by the host, or a transition to **Start Stream** initiated by the Device. The object of the host or device initiated transitions is to start moving data for a Stream. A host initiated transition to Move Data is referred to as a *Host Initiated Move Data* or **HIMD**. All Active Stream IDs are set to Ready by a HIMD.

Start Stream – This state is always initiated by device, and informs the host that the device wants to begin moving data on a selected Stream. The device may initiate a transition to this state anytime it has a Ready Stream ID. If the device selected Stream is accepted by

the host then the pipe enters the **Move Data** state. If the device selected Stream ID is rejected by the host then the pipe returns to **Idle** state and the selected Stream ID shall temporarily be considered Not Ready by the device. Note that a device maintains a list of the “Active” Stream IDs. An Active Stream ID may be Ready or Not Ready. The device is informed of the Active Stream IDs by the host through an out-of-band mechanism (typically a separate OUT endpoint).

Move Data – In this state, Stream data is transferred. The Current Stream is set when the SPSM transitions to this state. The SPSM transitions to the **Idle** state when the Stream transfer is complete, or if the host or device decides to terminate the Stream transfer because they have temporarily exhausted their data or buffer space. The transition to **Idle** invalidates the Current Stream (CStream) for the pipe.

(c). To Text and location: Replace Sections 8.12.1.4.2 and 8.12.1.2.3

The following sections (8.12.1.4.2 to 8.12.1.4.5) separate the Stream state machines into four cases for the device and host ends of a Stream pipe. Sections 8.12.1.4.2 and 8.12.1.4.3 describe the device end state machines. Sections 8.12.1.4.4 and 8.12.1.4.5 describe the host end state machines. And for each end of the pipe a separate section describes the respective IN and OUT operations.

The subsections in each Stream state machine section describe the state machine’s respective states. The subsections begin with a description of the purpose and general characteristics of the state, followed by a discussion of each of the states’ exit transitions. A paragraph that describes a states’ exit transition is preceded with a unique *condition* or *action* label of the associated exit transition in the previous state diagram figure.

Note: The U1 or U2 Timeouts in the path between the host and a device should be set to values that will prevent a transition to a U1 or U2 state for normal responses to Data Transactions. Refer to section 8.13 for more Data Transaction timing information.

Note: In the Stream state machine sections, the state names are overloaded, e.g. The **Idle** state is defined in all four state machine descriptions. The **INMvData Host** state is defined in both the device and host IN state machine sections, etc. The states are related in that they may occur at either end of a Stream pipe, however each Stream state machine section describes an independent state machine, so the conditions and actions associated with the states are distinct in each section.

Note: A transition condition that is italicized shall be interpreted as a comment, *not* a required condition. E.g. the “*Stream n Active and Ready*” text of the **Idle** to **Start Stream** transition of Figure 8-1.

Note: Any *CStream* data payload may be zero-length. The use of zero-length DPs on a Stream pipe (other than for Prime Pipe or Start Stream reject operations) is defined by the Device Class associated with the endpoint.

Note: An IN Data or Burst Transaction is terminated with an ACK TP with NumP = 0. This ACK TP is referred to as a “Terminating ACK” in the following sections.

8.12.1.4.2 Device IN Stream Protocol

This section defines the SuperSpeed packet exchanges that transition the device side of the Stream Protocol from one state to another on an IN bulk endpoint.

In the following text, a Device IN Stream state transition is assumed to occur at the point the device sends the first bit of the first symbol of a state machine related message to the host, or at the point the device first decodes state machine related message from the host.

For an IN pipe, Endpoint Buffers in the host receive Function Data from a device.

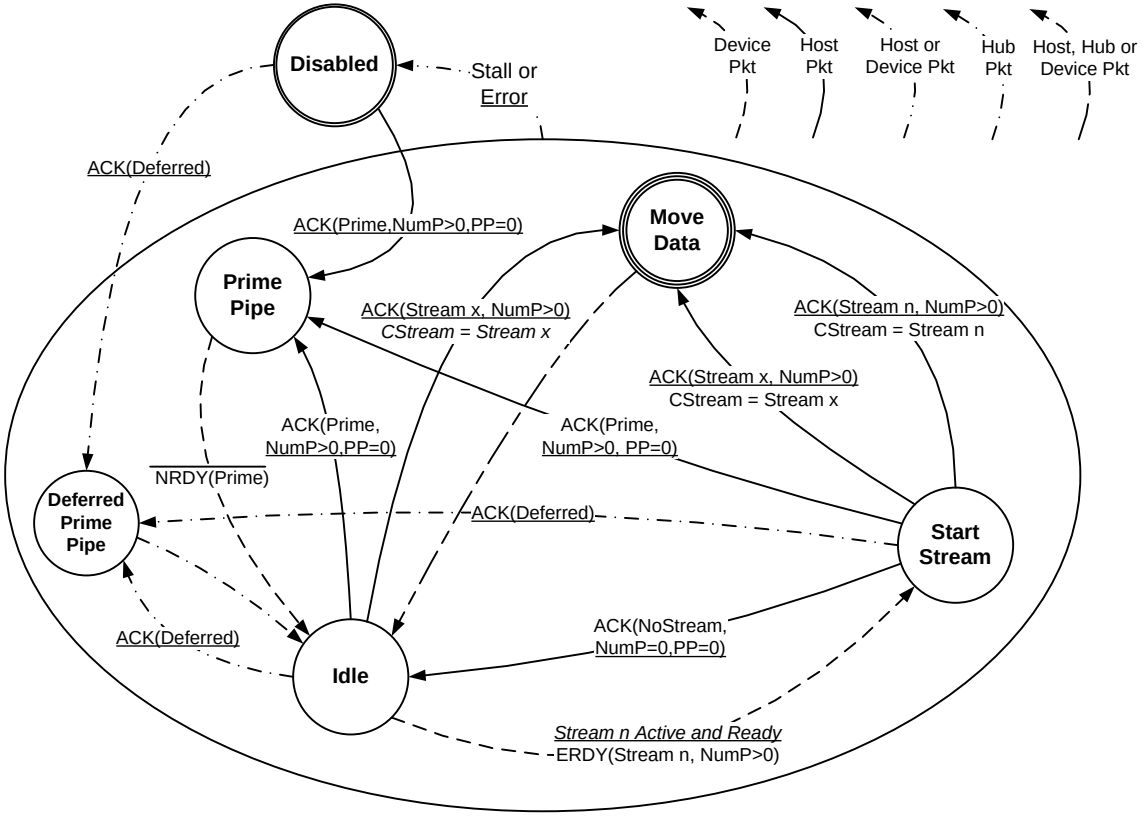

Figure 8-1. Device IN Stream Protocol State Machine (DISPSM)

8.12.1.4.2.1 Disabled

After an endpoint is configured, the pipe is in the **Disabled** state.

ACK(Prime, NumP>0, PP=0) - If an ACK TP with the Stream ID field set to *Prime* is received, then the device shall transition the pipe to the **Prime Pipe** state. This transition occurs after the initial Endpoint Buffers are assigned to the pipe by system software.

ACK(Deferred) - If an ACK with the Deferred (DF) flag set is received, then the device shall transition the pipe to the **Deferred Prime Pipe** state. This packet is received when the link has transitioned to a U1 or U2 state while waiting for the initial Endpoint Buffer assignment.

8.12.1.4.2.2 Prime Pipe

The **Prime Pipe** state informs the device that the Endpoint Buffers have been assigned to one or more Streams, however it does not specify which Stream(s). In this state, the device shall set all Active Streams to Ready. After returning to the **Idle** state the device shall issue an ERDY to start a specific Stream from its list of Active Streams.

NRDY(Prime) - Upon entering the **Prime Pipe** state, the device shall generate an NRDY TP with its Stream ID field set to *Prime* and transition to the **Idle** state.

8.12.1.4.2.3 Deferred Prime Pipe

The **Deferred Prime Pipe** state informs the device that the Endpoint Buffers have been assigned to one or more Streams, however the link has transitioned to a U1 or U2 state while waiting. In this state, the device shall set all Active Streams to Ready. After returning to the **Idle** state the device shall issue an ERDY to start a specific Stream from its list of Active Streams.

No Condition - Upon entering the **Deferred Prime Pipe** state, the device shall immediately transition to the **Idle** state. This is the only **Deferred Prime Pipe** exit transition in Figure 8-1.

8.12.1.4.2.4 Idle

In the **Idle** state, the pipe is waiting for a Stream selection (e.g., a transition to **Start Stream** or **Move Data**) or a notification from the host that a Stream Endpoint Buffer has been added or modified for the pipe (i.e. transition to **Prime Pipe**). Note that upon the initial entry in to **Idle** (i.e. from **Disabled**), only the device may initiate a Stream selection.

ERDY(Stream n, NumP>0) - To initiate a Stream selection, the device generates an ERDY TP with its Stream ID set to *Stream n* and a NumP value > 0, and transitions to the **Start Stream** state, where *Stream n* is the Stream ID proposed by the device. A device may initiate this transition when it wishes to start a Stream transfer, regardless of whether the pipe is in a flow control condition or not. The device maintains a list of *Active and Ready* Streams that it may generate ERDYs for. The method that a device uses for Stream selection is outside the scope of this specification and is normally defined by the Device Class associated with the pipe. Note that the value of the ERDY NumP field reflects the amount of Endpoint Data the device has available for *Stream n*.

ACK(Prime, NumP>0, PP=0) - If an ACK TP with a Stream ID equal to *Prime* is received from the host, the device shall transition to the **Prime Pipe** state.

ACK(Stream x, NumP>0) – With this transition the host proposes the Stream ID *Stream x* to the device. If an ACK TP with a Stream ID not equal to *Prime* is received from the host, the device shall transition to the **Move Data** state. The host may initiate this transition when it wishes to start a Stream transfer and is referred to as a *Host Initiated Move Data* or **HIMD**. A HIMD indicates the specific Stream that the Endpoint Buffer had been changed for. The device shall set *Stream x* to Ready due to this transition. After entering the **Move Data** state, the device may reject the proposed Stream with an NRDY or accept the proposed Stream with a DP. Upon transitioning to the **Move Data** state the device sets *CStream* to the value of the received Stream ID (*Stream x*). Typically *Stream x* will be equal to the Stream ID (*Stream n*) in the last ERDY generated by the device. *Stream x* may not be equal to *Stream n* if one of the race conditions described below occurs, because the host drops ERDYs under these conditions. PP should equal 1.

ACK(Deferred) - If an ACK with the Deferred (DF) flag set is received, then the device shall transition the pipe to the **Deferred Prime Pipe** state. This packet is received when the link has transitioned to a U1 or U2 state and the host has attempted a HIMD.

8.12.1.4.2.5 Start Stream

In the **Start Stream** state, the device is waiting for the host to accept or reject the Active and Ready Stream selection that it has proposed.

ACK(Stream n, NumP>0) - If an ACK TP with a Stream ID equal to *Stream n* is received, the host has accepted the device’s proposal for starting *Stream n* and the device shall transition to the **Move Data** state. Upon transitioning to the **Move Data** state the device sets *CStream* to the value of the received Stream ID (*Stream n*). PP should equal 1.

ACK(NoStream, NumP>0, PP=0) - If an ACK TP with a Stream ID equal to *NoStream* is received, the host has rejected the device’s proposal for starting *Stream n* and the device shall transition to the **Idle** state. The device shall set *Stream n* to Not Ready due to this transition. The host shall reject a proposal from a device if there are no Endpoint Buffers available for it.

ACK(Prime, NumP>0, PP=0) - If an ACK TP with a Stream ID equal to *Prime* is received, a race condition has occurred. The host has entered the **Prime Pipe** state to inform the device that the Endpoint Buffers for one or more Streams have been updated, at the same time that the device has attempted to initiate a Stream transfer, and their respective messages have passed each other on the link. During this condition, the device is in the **Start Stream** state and the host is in the **Prime Pipe** state. To resolve this condition, the device shall transition to the **Prime Pipe** state.

ACK(Stream x, NumP>0) - If an ACK TP with a Stream ID equal to *Stream x* is received, a race condition has occurred. The host has entered the **Move Data** state to initiate a transfer on *Stream x*, at the same time that the device has attempted to initiate a transfer on *Stream n*, and their respective messages have passed each other on the link. During this condition, the device is in the **Start Stream** state and the host is in the **Move Data** state. To resolve this condition, the device shall transition to the **Move Data** state. The device shall set *Stream x* to Ready due to this transition. Upon transitioning to the **Move Data** state the device sets *CStream* to the value of the received Stream ID (*Stream x*). PP should equal 1.

ACK(Deferred) - If an ACK with the Deferred (DF) flag set and the Stream ID field set to *Prime* is received, then the device shall transition the pipe to the **Deferred Prime Pipe** state. This packet is received when the link has transitioned to a U1 or U2 state while waiting for a host response to the Start Stream request. Note that this transition can occur only if the tERDYTimeout has been exceeded.

Note: The statement “PP should equal 1” in the **Idle** and **Start Stream** states, does not require the device to verify that PP equals 1 for the respective transition, however if a device does check the condition it should halt the EP if PP is not equal to 1.

8.12.1.4.2.6 Move Data

In the Device IN **Move Data** state, *CStream* is set to the same value at both ends of the pipe and the pipe may actively move data. The details of the bus transactions executed in the **Move Data** state and its exit conditions are defined in the Device IN Move Data State Machine defined below.

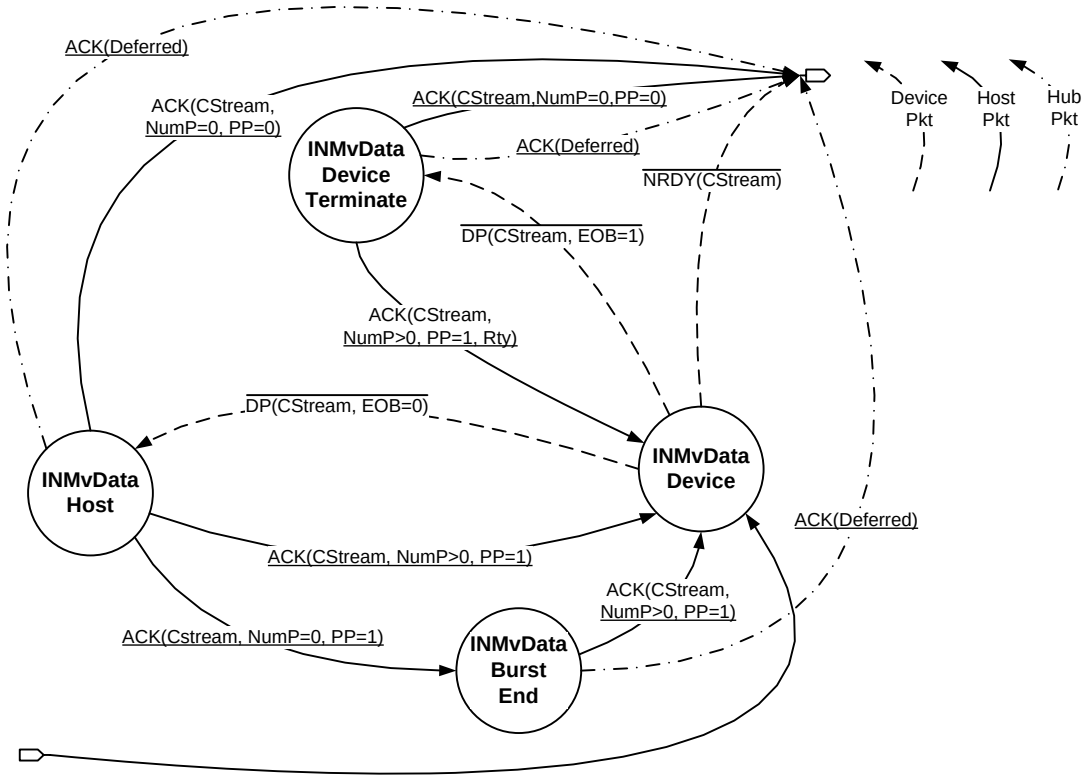

Figure 8-2. Device IN Move Data State Machine (DIMDSM)

The Device IN Move Data State Machine (DIMDSM) is entered from the **Start Stream** or **Idle** states as described above. The entry into the DIMDSM immediately transitions to the **INMvData Device** state. The DIMDSM allows either the device to terminate the Move Data operation because it has exhausted its Function Data associated with a Stream or the host to terminate the Move Data operation because it has exhausted its Endpoint Buffer space associated with a Stream.

The DIMDSM always exits to the **Idle** state. The Retry (Rty=1) flag shall never be set in a packet that causes a DIMDSM exit. A Stream pipe remains in the **Move Data** state during packet retries.

Note: The *Stream ID* value shall be *CStream* for all packets exchanged in the **Move Data** state. If a *Stream ID* value other than *CStream* is detected while in the DIMDSM the device should halt the endpoint.

Note: if *CStream* is not Active upon initially entering the **Move Data** state, the device may reject the Stream proposal with an NRDY or STALL the pipe, as defined by the associated Device Class.

8.12.1.4.2.7 INMvData Device

This state is initially entered from the **Start Stream** state or the **Idle** state. In this state the device prepares a DP to send to the host or may reject a HIMD from the host.

DP(CStream, EOB=0) - If the device’s Endpoint Data for *CStream* is greater than one Max Packet Size, then the device shall send a DP to the host with EOB = 0 and transition to the **INMvData Host** state. The DPP shall contain *CStream* data.

DP(CStream, EOB=1) - If the device’s Endpoint Data for *CStream* is less than or equal to one Max Packet Size, then the device shall send a DP to the host with EOB = 1 and transition to the **INMvData Device Terminate** state. The DPP shall contain *CStream* data.

NRDY(CStream) - The device may reject further *CStream* transfers by sending an NRDY with its Stream ID set to *CStream* and transition to the **Idle** state, exiting the DIMDSM. The device may generate this transition upon initial entry into the DIMDSM to reject a HIMD, or during a Stream transfer due to unexpected internal conditions where it wants to flow control *CStream*.

8.12.1.4.2.8 INMvData Host

In this state the device has just sent a DP to the host and has more Function Data available for *CStream*. The device waits in this state for an acknowledgement from the host for the last DP that it sent.

ACK(CStream, NumP>0, PP=1) - If the device receives an ACK with NumP > 0 and PP = 1, then it shall transition to the **INMvData Device** state. This is the host response if it has more Endpoint Buffer space available for a *CStream* DP from the device. Note that the Retry (Rty=1) flag may be set in this packet if the host detected an error in the last DP from the device. If Rty is set, then the device shall return the DP with the appropriate Sequence Number the next time it sends a DP. If a DP error is detected, the host shall continue the current burst until all retries are exhausted or a good packet is received.

ACK(CStream, NumP=0, PP=1) - If the device receives an ACK with NumP = 0 and PP = 1, then it shall transition to the **INMvData Burst End** state. This is the host response if it has more Endpoint Buffer space available for another *CStream* DP, however it must terminate the current burst from the device. Note that during the **INMvData Host** to **INMvData Device** transitions, the device should see NumP decrement towards 0 as the burst reaches completion.

ACK(CStream, NumP=0, PP=0) - If the device receives an ACK with NumP = 0, and PP = 0, then it shall transition to the **Idle** state, exiting the DIMDSM. This is the host response to a DP when it has accepted the last DP because it has exhausted its *CStream* Endpoint Buffer space. The device shall set *CStream* to Not Ready due to this transition. During the **INMvData Host** to **INMvData Device** transitions, the device should see NumP decrement towards 0 as the Endpoint Buffer is exhausted.

ACK(Deferred) - If an ACK with the Deferred (DF) flag set is received, then the device shall transition to the **Idle** state, exiting the DIMDSM. This packet is received when the link has transitioned to a U1 or U2 state while waiting for a host response with an ACK to a DP. Note that this transition is possible, but highly unlikely

Note: Receiving an ACK with NumP > 0 and PP = 0 is an illegal combination in the **INMvData Host** state and the device should halt the EP if detected.

8.12.1.4.2.9 INMvData Device Terminate

This state is entered because the device has just sent the last DP that it has available for *CStream*, e.g. it has exhausted its *CStream* Function Data. In this state the device waits for an acknowledgement from the host for the last DP of the **Move Data** transfer.

ACK(CStream, NumP=0, PP=0) - If the device receives an ACK with NumP = 0 and PP = 0, then it shall transition to the **Idle** state, exiting the DIMDSM. This is the normal host response (Terminating ACK) for acknowledging the last DP for *CStream* from the device.

ACK(CStream, NumP>0, PP=1, Rty) - If the device receives an ACK with Rty = 1, then it shall transition to the **INMvData Device** state and resend the packet in question. This is the host response if an error was detected on the DP from the device.

ACK(Deferred) - If an ACK with the Deferred (DF) flag set is received, then the device shall transition to the **Idle** state, exiting the DIMDSM. This packet is received when the link has transitioned to a U1 or U2 state while waiting for a host response to a DP. Note that this transition is possible, but highly unlikely.

8.12.1.4.2.10 INMvData Burst End

This state is entered because the host has terminated a burst on a stream pipe. In this state the device waits for an ACK TP that signifies the start of another burst.

ACK(CStream, NumP>0, PP=1) - If the device receives an ACK with NumP > 0 and PP = 1, then it shall transition to the **INMvData Device** state.

ACK(Deferred) - If an ACK with the Deferred (DF) flag set is received, then the device shall transition to the **Idle** state, exiting the DIMDSM. This transition occurs when the link has entered to a U1 or U2 state while waiting for the host to restart a burst, and this transition becomes more likely as the transfer activity associated with other devices increases.

8.12.1.4.3 Device OUT Stream Protocol

This section defines the SuperSpeed packet exchanges that transition the device side of the Stream Protocol from one state to another on an OUT bulk endpoint.

In the following text, a Device OUT Stream state transition is assumed to occur at the point the device sends the first bit of the first symbol of a state machine related message to the host, or at the point the device first decodes a state machine related message from the host.

For an OUT pipe, Endpoint Data in the host is transmitted to Function Buffers in a device. Unless otherwise stated, a DP will contain Endpoint Data.

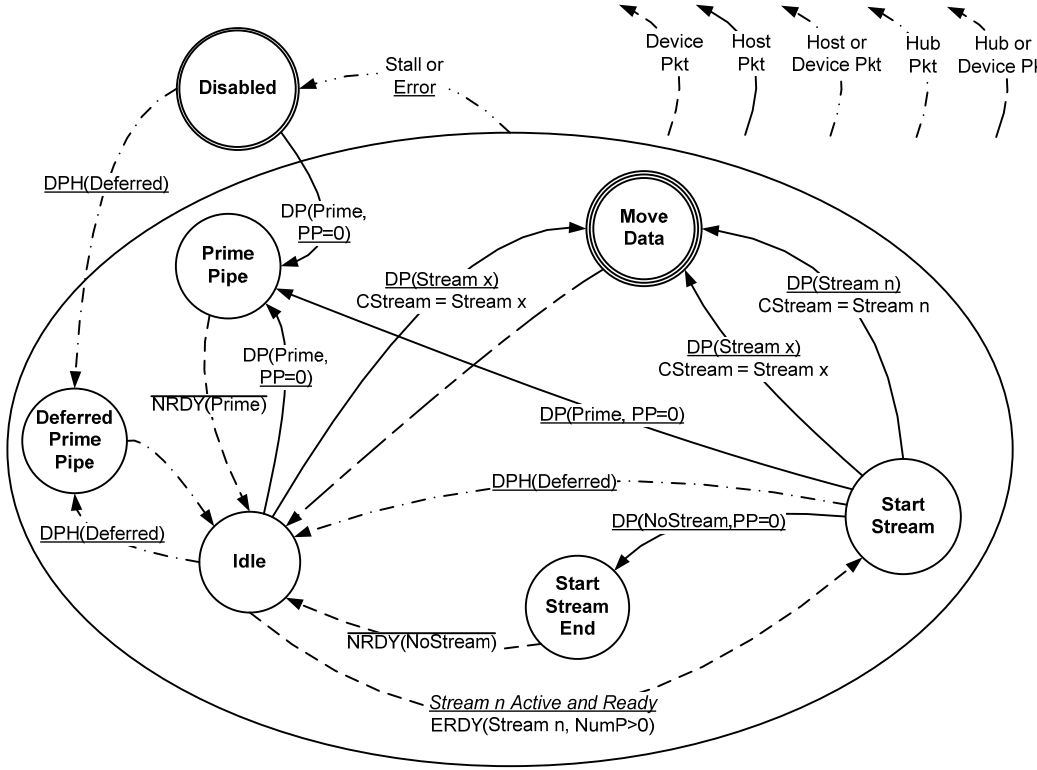

Figure 8-3. Device OUT Stream Protocol State Machine (DOSPSM)

8.12.1.4.3.1 Disabled

After an endpoint is configured, the pipe is in the **Disabled** state.

DP(Prime, PP=0) - If a DP with the Stream ID field set to *Prime* is successfully received, then the device shall transition the pipe to the **Prime Pipe** state. The DPP shall contain a zero-length data payload. This transition occurs after the initial Endpoint Buffers are assigned to the pipe by system software. Note, if an error is detected in the DP data (even though it is zero-length) the device shall remain in the **Disabled** state, and issue ACK(Prime, NumP>0, Rty) packets, retrying until a DP(Prime) is successfully received. This case is not illustrated in the Figure above.

DPH(Deferred) - If a DP with the Deferred (DF) flag set is received, then the device shall transition the pipe to the **Deferred Prime Pipe** state. This packet is received when the link has transitioned to a U1 or U2 state while waiting for the initial Endpoint Data assignment.

8.12.1.4.3.2 Prime Pipe

The **Prime Pipe** state informs the device that the Endpoint Data has been assigned to one or more Streams, however it does not specify which Stream(s). After returning to the **Idle** state the device shall issue an ERDY to start a specific Stream from its list of Active and Ready Streams.

NRDY(Prime) - Upon entering the **Prime Pipe** state, the device shall return an NRDY TP with its Stream ID field set to *Prime* and immediately transition to the **Idle** state.

8.12.1.4.3.3 Deferred Prime Pipe

The **Deferred Prime Pipe** state informs the device that the Endpoint Data has been assigned to one or more Streams, however the link has transitioned to a U1 or U2 state while waiting.

No Condition - Upon entering the **Deferred Prime Pipe** state, the device shall immediately transition to the **Idle** state.

8.12.1.4.3.4 Idle

In the **Idle** state, the pipe is waiting for a Stream selection (e.g., a transition to **Start Stream** or **Move Data**) or a notification from the host that Endpoint Data has been added or modified for the pipe (i.e. transition to **Prime Pipe**). Note that upon the initial entry in to **Idle**, only the device may initiate a Stream selection.

ERDY(Stream n, NumP>0) - To initiate a Stream selection, the device generates an ERDY TP with its Stream ID set to *Stream n* and a NumP value > 0, and transitions to the **Start Stream** state, where *Stream n* is the Stream ID proposed by the device. A device may initiate this transition when it wishes to start a Stream transfer, regardless of whether the pipe is in a flow control condition or not. The

device maintains a list of *Active and Ready* Streams that it may generate ERDYs for. The method that a device uses for Stream selection is outside the scope of this specification and is normally defined by the Device Class associated with the pipe. Note that the value of ERDY NumP reflects the amount of Endpoint Buffer space the device has available for *Stream n*.

DP(Prime, PP=0) - If a DP with a Stream ID equal to *Prime* is successfully received, the device shall transition to the **Prime Pipe** state. The DPP shall contain a zero-length data payload. Note, if an error is detected in the DP data the device shall remain in the **Idle** state, and issue ACK(Prime, NumP>0, Rty) packets, retrying until a DP(Prime) is successfully received. This case is not illustrated in the Figure above. The DPP shall contain a zero-length data payload.

DP(Stream x) - With this transition the host proposes the Stream ID *Stream x* to the device. If a DP with a Stream ID not equal to *Prime* is received from the host, the device shall transition to the **Move Data** state. The host may initiate this transition when it wishes to start a Stream transfer and is referred to as a *Host Initiated Move Data* or **HIMD**. A HIMD indicates the specific Stream that the Endpoint Data had been changed for. The device shall set *Stream x* to Ready due to this transition. After entering the **Move Data** state, the device may reject the proposed Stream with an NRDY or accept the proposed Stream with an ACK TP. Upon transitioning to the **Move Data** state the device sets *CStream* to the value of the received Stream ID (*Stream x*). The DPP shall contain the first data payload for the Stream. Typically *Stream x* will be equal to the Stream ID (*Stream n*) in the last ERDY generated by the device. *Stream x* may not be equal to *Stream n* if one of the race conditions described below occurs, because the host drops ERDYs under these conditions.

DPH(Deferred) - If a DPH with the Deferred (DF) flag set is received, then the device shall transition to the **Deferred Prime Pipe** state. This packet may be received when the link has transitioned to a U1 or U2 state and the host has attempted a transition to **Prime Pipe** or **Move Data** (a HIMD).

8.12.1.4.3.5 Start Stream

In the **Start Stream** state, the device is waiting for the host to accept or reject the Active and Ready Stream selection that it has proposed.

DP(Stream n) - If a DP with a Stream ID equal to *Stream n* is received: the host has accepted the device’s proposal for starting *Stream n* and provided the first packet of *Stream n* data, and the device shall transition to the **Move Data** state. Upon transitioning to the **Move Data** state the device sets *CStream* to the value of the received Stream ID (*Stream n*). The DPP shall contain the first data payload for *CStream*.

DP(NoStream, PP=0) - If a DP with a Stream ID equal to *NoStream* is successfully received, the host has rejected the device’s proposal for starting *Stream n* and the device shall transition to the **Start Stream End** state. The DPP shall contain a zero-length data payload. The host shall reject a proposal from a device if there is no Endpoint Data available for the Stream. The device shall set *Stream n* to Not Ready due to this transition. Note, if an error is detected in the DP data the device shall remain in the **Start Stream** state, and issue ACK(NoStream, NumP>0, Rty) packets, retrying until a DP(NoStream) is successfully received. This case is not illustrated in the Figure above.

DP(Prime, PP=0) - If a DP with a Stream ID equal to *Prime* is received, a race condition has occurred. The host has entered the **Prime Pipe** state to inform the device that Endpoint Data for one or more Streams has been posted, at the same time that the device has attempted to initiate a Stream transfer, and their respective messages have passed each other on the link. The DPP shall contain a zero-length data payload. During this condition, the device is in the **Start Stream** state and the host is in the **Prime Pipe** state. To resolve this condition, the device shall transition to the **Prime Pipe** state. Note, if an error is detected in the DP data the device shall transition to the **Prime Pipe** state and perform any retries there.

DP(Stream x) - If a DP with a Stream ID not equal to *Stream n*, *Prime* or *NoStream* (e.g. equal to *Stream x*) is received, a race condition has occurred. The host has entered the **Move Data** state to initiate a transfer on *Stream x*, at the same time that the device has attempted to initiate a transfer on *Stream n*, and their respective messages have passed each other on the link. During this condition, the device is in the **Start Stream** state and the host is in the **Move Data** state. To resolve this condition, the device shall transition to the **Move Data** state. The device shall set *Stream x* to Ready due to this transition. Upon transitioning to the **Move Data** state the device sets *CStream* to the value of the received Stream ID (*Stream x*). The DPP shall contain the first data payload for *CStream*. The device may accept or reject the Stream proposed by the host when in the **Move Data** state.

DPH(Deferred) - If a DPH with the Deferred (DF) flag set is received, then the device shall transition the pipe to the **Deferred Prime Pipe** state. This packet is received when the link has transitioned to a U1 or U2 state while waiting for a host response to the Start Stream request. Note that this transition is highly unlikely because it can only occur if the tERDYTimeout has been exceeded. The device is expected to retry with an ERDY in this case. There is no DPP associated with a deferred DPH.

8.12.1.4.3.6 Start Stream End

In the **Start Stream End** state, the device has received a rejection of the Stream selection that it has proposed, and must respond to the DP from the host. The Bulk protocol requires an ACK or NRDY response for any DP sent. The Streams protocol specifies that an NRDY is sent.

NRDY(NoStream) - The device shall generate an NRDY with the Stream ID equal to *NoStream* and transition to the **Idle** state.

8.12.1.4.3.7 Move Data

In the Device OUT **Move Data** state, *CStream* is set to the same value at both ends of the pipe and the pipe may actively move data. The details of the bus transactions executed in the **Move Data** state and its exit conditions are defined in the Device OUT Move Data State Machine defined below.

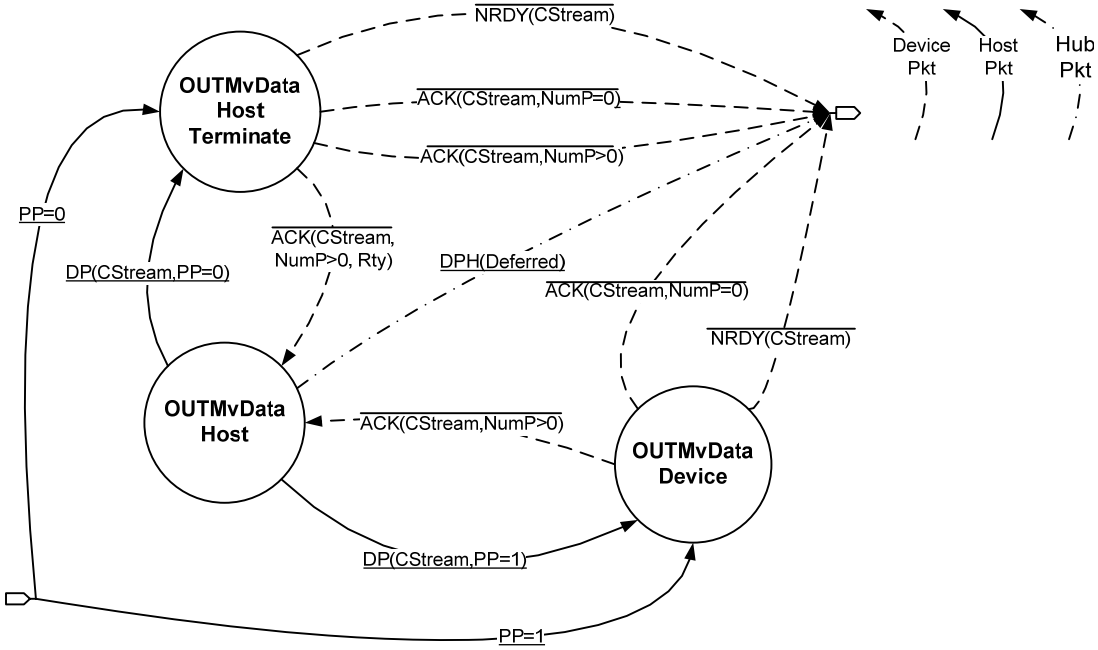

Figure 8-4. Device OUT Move Data State Machine (DOMDSM)

The Device OUT Move Data State Machine (DOMDSM) is entered from the **Start Stream** or **Idle** states as described above.

The DOMDSM allows either the device to terminate the Move Data operation because it has exhausted its Function Buffer space associated with a Stream or the host to terminate the Move Data operation because it has exhausted its Endpoint Data associated with a Stream.

PP=0 - Upon entry into the DOMDSM, if the host has only one packet of Endpoint Data available for the Stream then PP will equal 0 in the first DP received by the Device, and it shall transition to the **OUTMvData Device Terminate** state.

PP = 1 - Upon entry into the DOMDSM, if the host has more than one packet of Endpoint Data available for the Stream then PP will equal 1 in the first DP received by the Device, and it shall transition to the **OUTMvData Device** state.

The DOMDSM always exits to the **Idle** state. The Retry (Rty=1) flag shall never be set in a packet that causes a DOMDSM exit. A Stream pipe remains in the **Move Data** state during packet retries.

Note: The *Stream ID* value shall be *CStream* for all packets exchanged in the **Move Data** state. If a *Stream ID* value other than *CStream* is detected while in the DOMDSM the device should halt the endpoint.

Note: if *CStream* is not Active upon initially entering the **Move Data** state, the device may reject the Stream proposal with an NRDY or STALL the pipe, as defined by the associated Device Class.

8.12.1.4.3.8 OUTMvData Device

This state is initially entered from the **Start Stream** state or the **Idle** state. In this state the device acknowledges the last DP sent by the host or it may reject a HIMD from the host.

ACK(CStream, NumP>0) - If the device has more Function Buffer space available for *CStream*, then it shall send an ACK TP to the host with NumP > 0 and transition to the **OUTMvData Host** state. Note that the Retry (Rty) flag may be set in this packet if the device detected an error in the last DP from the host. The host shall continue the current burst until all retries are exhausted or a positive acknowledgement (Rty=0) is received. This transition shall indicate that the data payload of the previously received DP has been accepted by the endpoint for *CStream*.

ACK(CStream, NumP=0) - If the device has no more Endpoint Buffer space available for *CStream*, then it shall generate an ACK TP with NumP = 0, exit the DOMDSM and transition to the **Idle** state. This transition allows the device to exit from the **Move Data** state

if its Endpoint Buffer space is exhausted. This transition shall indicate that the data payload of the previously received DP has been accepted by the endpoint for *CStream*.

NRDY(CStream) - The device may also terminate further *CStream* transfers by sending an NRDY with its Stream ID set to *CStream*, transitioning to the **Idle** state, exiting the DOMDSM. The device may generate this transition upon initial entry into the DOMDSM to reject a HIMD, or during a Stream transfer due to unexpected internal conditions where it wants to flow control *CStream*. This transition shall indicate that the data payload of the previously received DP has been dropped.

8.12.1.4.3.9 OUTMvData Host

In this state the host has just received an ACK TP from the device for a previous DP and has more Endpoint Data available for *CStream*. The host generates a DP in this state. The pipe will also wait in this state between bursts from the host.

DP(CStream, PP=1) - If the device receives a DP with PP = 1, then it shall transition to the **OUTMvData Device** state. The DPP shall contain a *CStream* data payload. This is the host response if it has more than one Max Packet Size of Endpoint Data available for *CStream*.

DP(CStream, PP=0) - If the device receives a DP with PP = 0, then it shall transition to the **OUTMvData Host Terminate** state. The DPP shall contain a *CStream* data payload. This is the host response if it has exhausted the Endpoint Data that it has available for *CStream*. The length of the DP will be less than or equal to one Max Packet Size.

DPH(Deferred) - If a DPH with the Deferred (DF) flag set is received, then the device shall transition to the **Idle** state, exiting the DOMDSM. This packet is received when the link has transitioned to a U1 or U2 state while waiting for the next DP from the host. There is no DPP associated with a deferred DPH.

8.12.1.4.3.10 OUTMvData Host Terminate

This state is entered because the host has just sent the last DP that it has available for *CStream*, e.g. it has exhausted its *CStream* Endpoint Data. In this state the device acknowledges the last DP from the host for the **Move Data** transfer.

ACK(CStream, NumP=0) - If the device has also exhausted its Function Buffer space, then it shall generate an ACK TP with NumP = 0 and transition to the **Idle** state, exiting the DOMDSM.

ACK(CStream, NumP>0) - If the device has not exhausted its Function Buffer space, then it shall generate an ACK TP with NumP > 0, and transition to the **Idle** state, exiting the DOMDSM. The device shall set *CStream* to Not Ready due to this transition.

ACK(CStream, NumP>0, Rty) - If an error was detected on the last DP by the device, then it shall generate an ACK TP with NumP > 0 and Rty = 1, so that the host will retry the last DP. The device shall then transition to the **OUTMvData Host** state.

NRDY(CStream) - The device may flow control on the last *CStream* transfer by sending an NRDY with its Stream ID set to *CStream* and transition to the **Idle** state, exiting the DOMDSM. The device may generate this transition due to unexpected internal conditions where it wants to flow control *CStream*.

8.12.1.4.4 Host IN Stream Protocol

This section defines the SuperSpeed packet exchanges that transition the host side of the Stream Protocol from one state to another on an IN bulk endpoint.

In the following text, a Host IN Stream state transition is assumed to occur at the point the host sends the first bit of the first symbol of a state machine related message to the device, or at the point the host first decodes state machine related message from the device.

For an IN pipe, Endpoint Buffers in the host receive Function Data from a device.

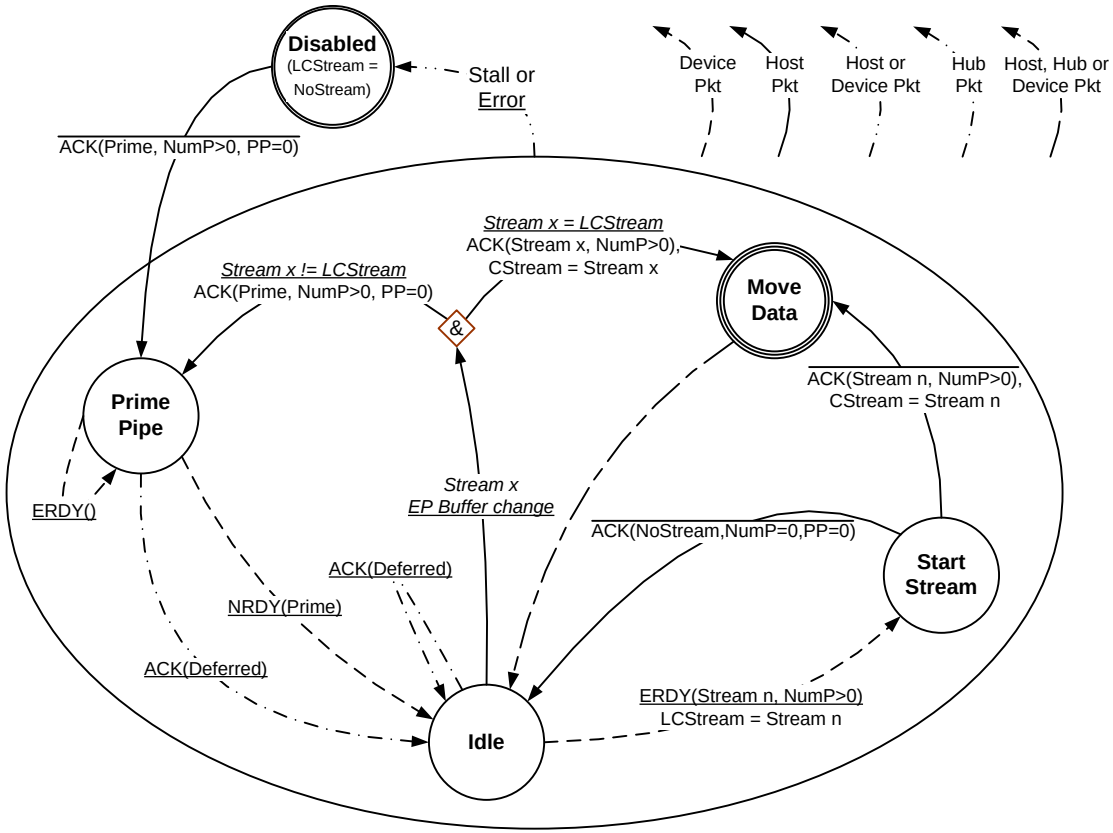

Figure 8-5. Host IN Stream Protocol State Machine (HISPSM)

8.12.1.4.4.1 Disabled

After an endpoint is configured, the pipe is in the **Disabled** state and *LCStream* is initialized to *NoStream*.

ACK(Prime, NumP>0, PP=0) - When the initial Endpoint Buffers are assigned to the pipe by system software, the host shall send an ACK TP with the Stream ID field set to *Prime* to the device, and transition the pipe to the **Prime Pipe** state.

8.12.1.4.4.2 Prime Pipe

The **Prime Pipe** state informs the device that the Endpoint Buffers have been assigned to one or more Streams.

NRDY(Prime) – If the host receives an NRDY TP with its Stream ID field set to *Prime*, it shall transition to the **Idle** state. This transition is the normal termination of a Prime Pipe operation.

ACK(Deferred) - If an ACK with the Deferred (DF) flag set is received, then the host shall transition the pipe to the **Idle** state. This packet may be received when the link has transitioned to a U1 or U2 state while the pipe was waiting for its initial Endpoint Buffer assignment. e.g. after an ACK(Prime, NumP>0, PP=0) has been generated in the **Disabled** state.

ERDY() - If an ERDY is received, a race condition has occurred. During this condition, the device is in the **Start Stream** state and the host is in the **Prime Pipe** state. The host has entered the **Prime Pipe** state to inform the device that the Endpoint Buffers for one or more Streams have been updated, at the same time that the device has attempted to initiate a Stream transfer, and their respective messages have passed each other on the link. To resolve this condition, the host shall remain in the **Prime Pipe** state and wait for an NRDY(Prime) from the device.

8.12.1.4.4.3 Idle

In the **Idle** state, the pipe is waiting for a Stream selection (e.g., a transition to **Start Stream** or **Move Data**) or a notification from the host that Stream Endpoint Data has been added or modified for the pipe (i.e. transition to **Prime Pipe**). Note that upon the initial entry in to **Idle** (i.e. from **Disabled**), only the device may initiate a Stream selection.

ERDY(Stream n, NumP>0) – If an ERDY is received, the host shall transition to the **Start Stream** state. The device generates an ERDY to select a specific Stream (*Stream n*) that it expects the host to begin IN transactions on. A device may initiate this transition when it wishes to start a Stream transfer, regardless of whether it had previously flow controlled the pipe or not. Note that the value of the ERDY NumP field reflects the amount of Endpoint Data the device has available for *Stream n*. The value of the ERDY NumP is informative and The method that a device uses for Stream selection is outside the scope of this specification and is normally defined by the Device Class associated with the pipe. Upon transitioning to the **Start Stream** state the host sets *LCStream* to the value of *Stream n*.

ACK(Deferred) - If an ACK with the Deferred (DF) flag set is received, then the host shall remain in the **Idle** state. This packet is received if the link has transitioned to a U1 or U2 state when the host rejects a Start Stream request from the device (i.e. due to an ACK(NoStream, NumP=0, PP=0)). This case only occurs if tERDYTimeout is exceeded.

Stream x EP Buffer Change - This transition occurs if the state of one or more Endpoint Buffers has changed in the host. The host evaluates (at the Joint “**&**”) the ID of the Stream that software presents to the host controller (*Stream x*) and transitions to the **Prime Pipe** or **Move Data** states. This is an optimization that allows the host to transition the Stream pipe directly to the **Move Data** state, rather than going through the **Prime Pipe**, **Start Stream**, **Move Data** sequence, and is referred to as a *Host Initiated Move Data* or **HIMD**. The specific algorithm used to make this decision is host specific.

&

ACK(Prime, NumP>0, PP=0) - If the transition to **Prime Pipe** is selected, then the host shall generate a ACK TP with the Stream ID = *Prime*, NumP > 0, and PP = 0, and transition to the **Prime Pipe** state. Note that the host asserts a non-zero NumP value so that the device may respond with an NRDY. If NumP = 0, the device would consider it a Terminating ACK and not respond. Typically the **Prime Pipe** transition will be selected when the Stream that has just had its host Endpoint Buffers modified is not the same Stream that the device has last selected, e.g. *Stream x != LCStream*.

ACK(Stream x, NumP>0) - If the transition to **Move Data** is selected, then the host shall generate a ACK TP with the Stream ID = *Stream x* and NumP > 0, and transition to the **Move Data** state. Upon transitioning to the **Move Data** state the host sets *CStream* to the value of *Stream x*. Typically the **Move Data** transition will be selected when the Stream that has just had its Endpoint buffers modified is the same Stream as the one that the device last selected, e.g. *Stream x = LCStream*. PP shall equal 1 because the host is capable of receiving another DP from the device. This transition optionally may be disabled in some hosts, and some Device Classes may not process this transition (e.g. Mass Storage UASP).

8.12.1.4.4.4 Start Stream

In the **Start Stream** state, the device has sent an ERDY proposing to the host that it initiate an IN transfer for *Stream n* and it is waiting for the host to accept or reject the Stream selection.

ACK(Stream n, NumP>0) - If the host has accepted the device’s proposal for starting *Stream n*, then it shall transmit an ACK TP with a Stream ID equal to *Stream n*, and transition to the **Move Data** state. Upon transitioning to the **Move Data** state the host sets

CStream to the value of *Stream n*. The host shall accept a Stream proposal from a device if there are Endpoint Buffers available to receive the Function Data for the Stream. PP shall equal 1 because the host is capable of receiving another DP from the device.

ACK(NoStream, NumP=0, PP = 0) - If the host rejects the device’s proposal for starting *Stream n*, then it shall transmit an ACK TP with a Stream ID equal to *NoStream*, and transition to the **Idle** state. The host shall reject a Stream proposal from a device if there are no Endpoint Buffers available to receive the Function Data for the Stream.

8.12.1.4.4.5 Move Data

In the Host IN **Move Data** state, *CStream* is set to the same value at both ends of the pipe and the pipe may actively move data. The details of the bus transactions executed in the **Move Data** state and its exit conditions are defined in the Host IN Move Data State Machine defined below.

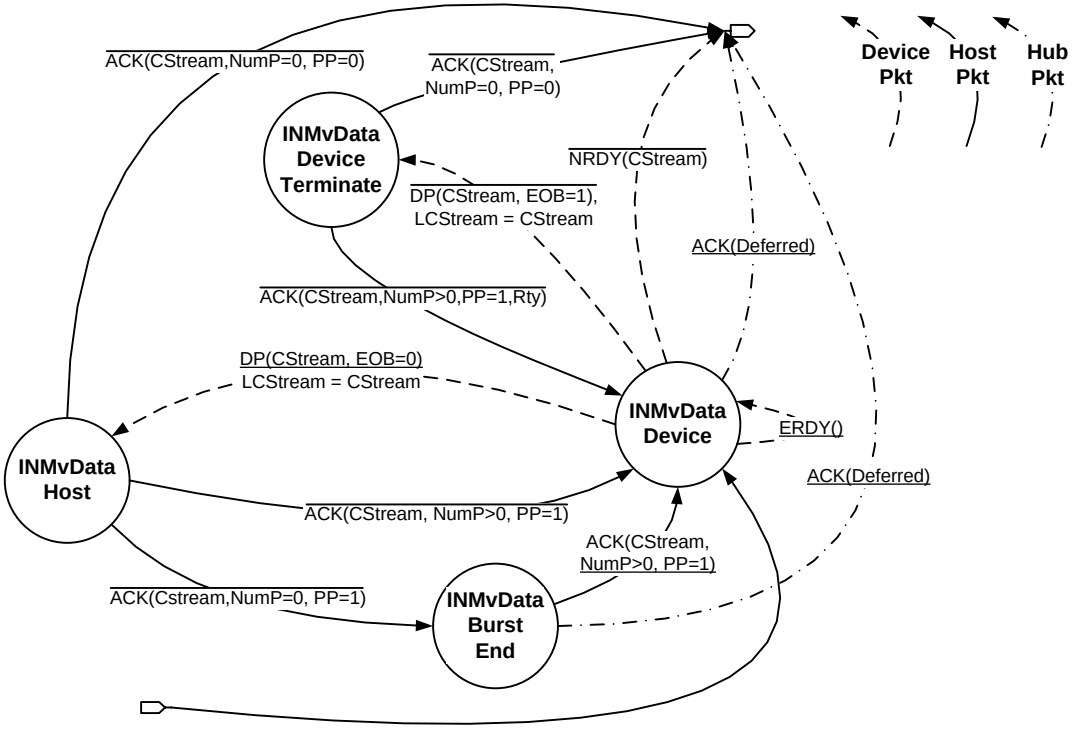

Figure 8-6. Host IN Move Data State Machine (HIMDSM)

The Host IN Move Data State Machine (HIMDSM) is entered from the **Start Stream** or **Idle** states as described above. The entry into the HIMDSM immediately transitions to the **INMvData Device** state. The HIMDSM allows either the device to terminate the Move Data operation because it has exhausted its Function Data associated with a Stream or the host to terminate the Move Data operation because it has exhausted its Endpoint Buffer space associated with a Stream.

The HIMDSM always exits to the **Idle** state. The Retry (Rty=1) flag shall never be set in a packet that causes a HIMDSM exit. A Stream pipe remains in the Move Data state during packet retries.

Note: The *Stream ID* value shall be *CStream* for all packets exchanged in the **Move Data** state, except the **INMvData Device** substate ERDY transition. For the identified substates, if a *Stream ID* value other than *CStream* is detected while in the HIMDSM the host should halt the endpoint.

8.12.1.4.4.6 INMvData Device

This state is initially entered from the **Start Stream** state or the **Idle** state. In this state the host is waiting for a DP from the device or a rejection of a HIMD.

DP(CStream, EOB=0) - If the host receives a DP with EOB = 0, it shall copy the DP data to the Endpoint Buffer associated with the Stream and transition to the **INMvData Host** state. The DPP shall contain a *CStream* data payload. This transition occurs when the device returns IN data and has more Function Data to send. Upon transitioning to the **INMvData Host** state the host sets *LCStream* to the value of *CStream*. This action updates *LCStream* with the value of *CStream* if the device accepts a HIMD, i.e. *LCStream* records the last Stream that was of interest to the device.

DP(CStream, EOB=1) - If the host receives a DP with EOB = 1, it shall copy the DP data to the Endpoint Buffer associated with the Stream and transition to the **INMvData Device Terminate** state. The DPP shall contain a *CStream* data payload. This transition occurs when device returns IN data and has no more Function Data to send, e.g. it is terminating the Move Data operation because this DP exhausts the Function Data available for this Stream. Upon transitioning to the **INMvData Device Terminate** state the host sets *LCStream* to the value of *CStream*. This action updates *LCStream* with the value of *CStream* if the device accepts a HIMD, i.e. *LCStream* records the last Stream that was of interest to the device.

NRDY(CStream) - If the host receives an NRDY, it shall exit the HIMDSM and transition to the **Idle** state. This transition may occur upon initial entry into the HIMDSM when the device rejects a HIMD, or during a Stream transfer due to unexpected internal device conditions where it wants to flow control *CStream*.

ACK(Deferred) - If the host receives an ACK with the Deferred (DF) flag set, then it shall exit the HIMDSM and transition to the **Idle** state. This packet shall be received if a link in the path between the host and the device has transitioned to a U1 or U2 state. There are three cases when this transition may occur: 1) the host has attempted a HIMD, 2) between bursts, and 3) an ACK response from the host is delayed. Case 1 is likely to occur if there has been a long host delay in obtaining buffers for the Stream. Case 2 may occur if there is a lot of endpoint activity on other devices delaying the time between bursts. Case 3 is unlikely because the U1 or U2 Timeouts in the path to a device should be set to values that will prevent a transition to a U1 or U2 state for normal host responses to Data

Transactions. The device treats this transition like a Prime Pipe and will send an ERDY to restart the stream when it receives the Deferred ACK forwarded to it by a hub.

ERDY() - If an ERDY is received, a race condition has occurred. During this condition, the device is in the **Start Stream** state and the host is in the **Move Data** state. The host has entered the **Move Data** state as the result of a HIMD, at the same time that the device has attempted to initiate a Stream transfer, and their respective messages have passed each other on the link. To resolve this condition, the host shall remain in the **INMvData Device** state and wait for a DP or an NRDY from the device.

8.12.1.4.4.7 INMvData Host

In this state the host has received a DP from a device that has more Function Data available for *CStream*. The host responds with an acknowledgement after copying the received data to the Endpoint Buffer space associated with the Stream.

ACK(CStream, NumP>0, PP=1) - If more Endpoint Buffer space is available for the Stream and the host is continuing the current burst to the device, then the host shall generate an ACK TP with NumP > 0 and PP = 1, and transition to the **INMvData Device** state. If the host detected an error on the last DP from the device, then the Rty flag shall be set. The host shall continue the **INMvData Host** to **INMvData Device** loop until all retries are exhausted or a good packet is received by the device.

ACK(CStream, NumP=0, PP=1) - If more Endpoint Buffer space is available for the Stream, however the host must terminate the current burst to the device, then the host shall generate an ACK TP with NumP = 0 and PP = 1, and transition to the **INMvData Burst End** state.

ACK(CStream, NumP=0, PP=0) - If the Endpoint Buffer space is available for the Stream is exhausted by the last DP received, then the host shall generate an ACK TP with NumP = 0 and PP = 0, and transition to the **Idle** state, exiting the HIMDSM. This transition informs the device the host has exhausted its Endpoint Buffer space for the Stream.

8.12.1.4.4.8 INMvData Burst End

This state is entered because the host has terminated a burst on a stream pipe. The host will exit this state when it is ready to start another burst.

ACK(CStream, NumP>0, PP=1) - When ready to start another burst to the device on *CStream*, the host shall generate an ACK with NumP > 0 and PP = 1 and transition to the **INMvData Device** state.

ACK(Deferred) - If an ACK with the Deferred (DF) flag set is received, then the host shall transition to the **Idle** state, exiting the HIMDSM. This transition is highly unlikely, but may occur if a link has transitioned to a U1 or U2 state between receiving the last DP in the **INMvData Host** state and sending the Terminating ACK to end a burst.

8.12.1.4.4.9 INMvData Device Terminate

In this state the host has received the last DP from a device for this Move Data operation because the device has exhausted the Function Data it has available for *CStream*. The host responds with an acknowledgement after copying the received data to the Endpoint Buffer space associated with the Stream and exits the HIMDSM.

ACK(CStream, NumP=0, PP=0) - If the packet received from the device is good, then the host generates an ACK with NumP = 0, PP = 0 and Rty = 0, and transitions to the **Idle** state, exiting the HIMDSM.

ACK(CStream, NumP=0, PP=1, Rty) - If the packet received from the device is bad, then the host generates an ACK with NumP = 0, PP = 1 and Rty = 1, and transitions to the **INMvData Device** state. The host shall continue the **INMvData Device Terminate** to **INMvData Device** loop until all retries are exhausted or a good packet is received.

8.12.1.4.5 Host OUT Stream Protocol

This section defines the SuperSpeed packet exchanges that transition the host side of the Stream Protocol from one state to another on an OUT bulk endpoint.

In the following text, a Host OUT Stream state transition is assumed to occur at the point the host sends the first bit of the first symbol of a state machine related message to the device, or at the point the host first decodes state machine related message from the device.

For an OUT pipe, Function Buffers in the device receive Endpoint Data from the host.

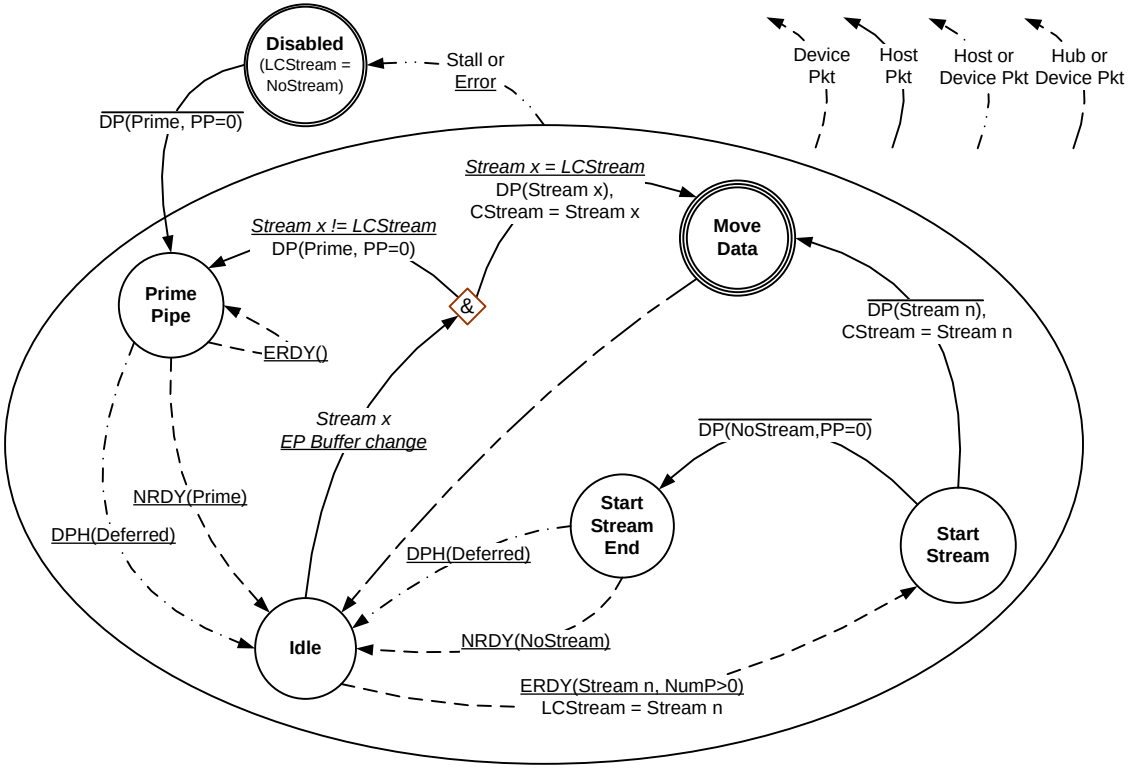

Figure 8-7. Host OUT Stream Protocol State Machine (HOSPSM)

8.12.1.4.5.1 Disabled

After an endpoint is configured, the pipe is in the **Disabled** state and *LCStream* is initialized to *NoStream*.

DP(Prime, PP=0) - When the initial Endpoint Data is assigned to the pipe by system software, the host shall send a zero-length DP with the Stream ID field set to *Prime* to the device, and transition the pipe to the **Prime Pipe** state. The DPP shall contain a zero-length data payload.

8.12.1.4.5.2 Prime Pipe

The **Prime Pipe** state informs the device that Endpoint Buffers have been assigned to one or more Streams. Note, this state is entered when the host transmits a DP(Prime) from the **Disabled** or the **Idle** state. If an error is detected in the DP data by the device, the device shall issue ACK(Prime, NumP>0, Rty) packet, retrying until a DP(Prime) is successfully received. The host shall retransmit the DP(Prime) and remain in the **Prime Pipe** state until the device successfully receives the DP(Prime) and returns an NRDY(Prime), or the retries for the pipe are exhausted and the host halts the pipe. This case is not illustrated in the Figure above.

NRDY(Prime) – If the host receives an NRDY TP with its Stream ID field set to *Prime*, it shall transition to the **Idle** state. This transition is the normal termination of a Prime Pipe operation.

DPH(Deferred) - If a DPH with the Deferred (DF) flag set is received, then the host shall transition the pipe to the **Idle** state. This packet may be received when the link has transitioned to the U1 or U2 state while the pipe waiting for its initial Endpoint Buffer assignment. e.g. after a DP(Prime, PP=0) has been generated in the **Disabled** state. There is no DPP associated with a deferred DPH.

ERDY() - If an ERDY is received, a race condition has occurred. During this condition, the device is in the **Start Stream** state and the host is in the **Prime Pipe** state. The host has entered the **Prime Pipe** state to inform the device that the Endpoint Buffers for one or more Streams have been updated, at the same time that the device has attempted to initiate a Stream transfer, and their respective messages have passed each other on the link. To resolve this condition, the host shall remain in the **Prime Pipe** state and wait for an NRDY from the device.

8.12.1.4.5.3 Idle

In the **Idle** state, the pipe is waiting for a Stream selection (e.g., a transition to **Start Stream** or **Move Data**) or a notification from the host that Stream Endpoint Data has been added or modified for the pipe (i.e. transition to **Prime Pipe**). Note that upon the initial entry in to **Idle** (i.e. from **Disabled**), only the device may initiate a Stream selection.

ERDY(Stream n, NumP>0) – If an ERDY is received, the host shall transition to the **Start Stream** state. The device generates an ERDY to select a specific Stream (*Stream n*) that it expects the host to begin OUT transactions on. A device may initiate this transition when it wishes to start a Stream transfer, regardless of whether it had previously flow controlled the pipe or not. Note that the value of the ERDY NumP field reflects the amount of Endpoint Buffer space the device has available for *Stream n*. The method that a device uses for Stream selection is outside the scope of this specification and is normally defined by the Device Class associated with the pipe. Upon transitioning to the **Start Stream** state the host sets *LCStream* to the value of *Stream n*.

Stream x EP Buffer Change - This transition occurs if Endpoint Data has been posted for one or more Streams in the host. The host evaluates (at the Joint "**&**") the ID of the Stream that software presents to the host controller (*Stream x*) and transitions to the **Prime Pipe** or **Move Data** states. This is an optimization that allows the host to transition the Stream pipe directly to the **Move Data** state, rather than going through the **Prime Pipe**, **Start Stream**, **Move Data** sequence, and is referred to as a *Host Initiated Move Data* or **HIMD**. The specific algorithm used to make this decision is host specific.

&

DP(Prime, PP=0) - If the transition to **Prime Pipe** is selected, then the host shall generate a DP with the Stream ID = *Prime* and PP = 0, and transition to the **Prime Pipe** state. The DPP shall contain a zero-length data payload. Typically the **Prime Pipe** transition will be selected when the Stream that has just had its Endpoint Data modified is not the same Stream that the device has last selected, e.g. *Stream x != LCStream*.

DP(Stream x) - If the transition to **Move Data** is selected, then the host shall generate a DP with the Stream ID = *Stream x*, and transition to the **Move Data** state. Upon transitioning to the **Move Data** state the host sets *CStream* to the value of *Stream x*. The DPP shall contain the first data payload for *CStream*. Typically the **Move Data** transition will be selected when the Stream that has just had its Endpoint Data modified is the same Stream as the one that the device last selected, e.g. *Stream x = LCStream*. The value of PP shall depend on the amount of Endpoint Buffer space the host has available. If the host has more than Max Packet Size Endpoint Data available for the Stream, then PP = 1 else PP = 0. This transition may be optionally be disabled in some hosts, and some Device Classes may not process this transition (e.g. Mass Storage UASP).

8.12.1.4.5.4 Start Stream

In the **Start Stream** state, the device has sent an ERDY proposing to the host that it initiate an OUT transfer for *Stream n* and it is waiting for the host to accept or reject the Stream selection.

DP(Stream n) - If the host has accepted the device's proposal for starting *Stream n*, then it shall transmit a DP with a Stream ID equal to *Stream n*, and transition to the **Move Data** state. Upon transitioning to the **Move Data** state the host sets *CStream* to the value of *Stream n*. The DPP shall contain the first data payload for *CStream*. The host shall accept a Stream proposal from a device if there is Endpoint Data available for the Stream.

DP(NoStream, PP = 0) - If the host rejects the device’s proposal for starting *Stream n*, then it shall transmit a DP with a Stream ID equal to *NoStream*, and transition to the **Start Stream End** state. The DPP shall contain a zero-length data payload. The host shall reject a Stream proposal from a device if there is no Endpoint Data available to send for the Stream.

8.12.1.4.5.5 Start Stream End

In the **Start Stream End** state, the host has rejected a proposed Stream ID from the device because there was no Endpoint Data available for *Stream n*. Note, this state is entered when the host transmits a DP(NoStream) from the **Start Stream** state. If an error is detected in the DP data by the device, the device shall issue ACK(NoStream, NumP>0, Rty) packet, retrying until a DP(NoStream) is successfully received. The host shall retransmit the DP(NoStream) and remain in the **Start Stream End** state until the device successfully receives the DP(NoStream) and returns an NRDY(NoStream), or the retries for the pipe are exhausted and the host halts the pipe. This case is not illustrated in the Figure above.

NRDY(NoStream) – If an NRDY with the Stream ID equal to *NoStream* is received, the host shall transition to the **Idle** state.

DPH(Deferred) - If a DPH with the Deferred (DF) bit set is received, the host shall transition to the **Idle** state. This packet is received when the link has transitioned to a U1 or U2 state while waiting for a host response to the Start Stream request. Note that this transition can occur only if the tERDYTimeout has been exceeded. There is no DPP associated with a deferred DPH.

8.12.1.4.5.6 Move Data

In the Host OUT **Move Data** state, *CStream* is set to the same value at both ends of the pipe and the pipe may actively move data. The details of the bus transactions executed in the **Move Data** state and its exit conditions are defined in the Host OUT Move Data State Machine defined below.

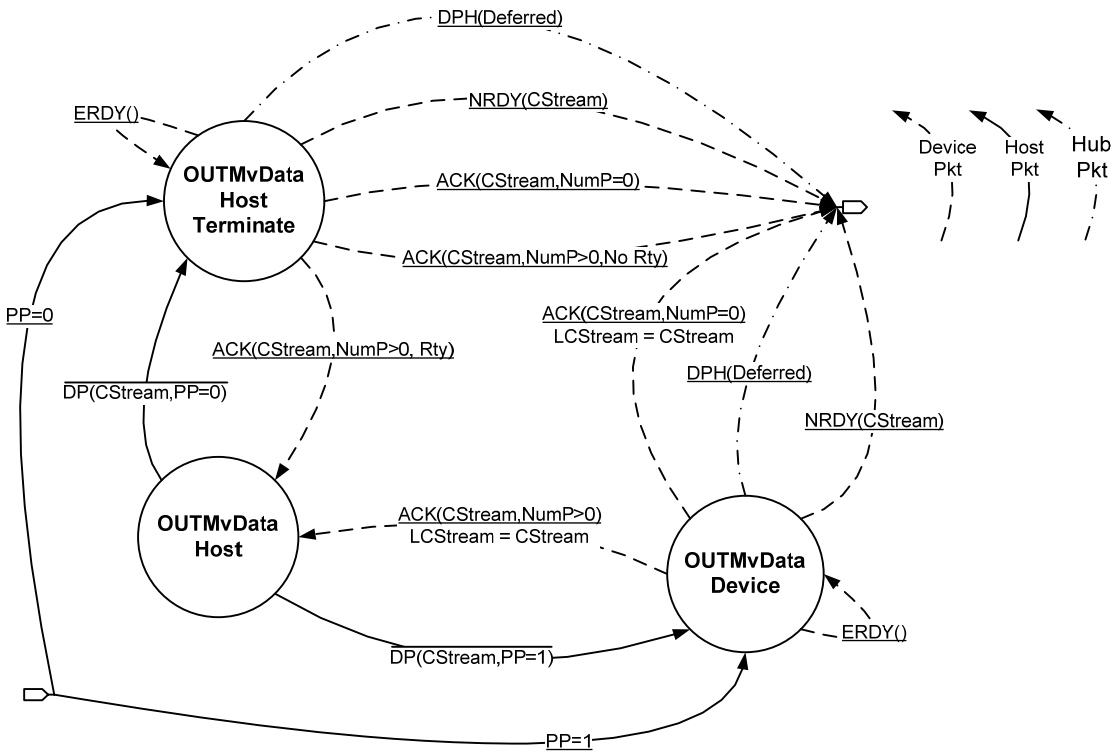

Figure 8-8. Host OUT Move Data State Machine (HOMDSM)

The Host OUT Move Data State Machine (HOMDSM) is entered from the **Start Stream** or **Idle** states as described above. The entry into the HOMDSM immediately transitions to the **OUTMvData Device** state. The HOMDSM allows either the device to terminate the Move Data operation because it has exhausted its Function Buffer space associated with a Stream or the host to terminate the Move Data operation because it has exhausted its Endpoint Data associated with a Stream.

PP = 0 - Upon entry into the HOMDSM, if the host has only one packet of Endpoint Data available for the Stream then PP will equal 0 in the first DP sent to the Device, and it shall transition to the **OUTMvData Device Terminate** state.

PP = 1 - Upon entry into the HOMDSM, if the host has more than one packet of Endpoint Data available for the Stream then PP will equal 1 in the first DP sent to the Device, and it shall transition to the **OUTMvData Device** state.

The HOMDSM always exits to the **Idle** state. The Retry (Rty=1) flag shall never be set in a packet that causes a HOMDSM exit. A Stream pipe remains in the Move Data state during packet retries.

Note: The *Stream ID* value shall be *CStream* for all packets exchanged in the **Move Data** state, except the **OUTMvData Device** substate ERDY transition. For the identified substates, if a *Stream ID* value other than *CStream* is detected while in the HOMDSM the host should halt the endpoint.

8.12.1.4.5.7 OUTMvData Device

This state is initially entered from the **Start Stream** state or the **Idle** state. In this state the host is waiting for an ACK TP or a rejection of a HIMD from the device.

ACK(CStream, NumP>0) - If the host receives an ACK TP with NumP > 0, it shall transition to the **INMvData Host** state. This transition occurs when device has more Function Buffer space available for the stream. If the device detected an error on the last DP from the host, then the Retry (Rty) flag shall be set. If a Retry is requested, the host shall continue the current burst until all retries are exhausted or a good packet is transmitted. The host shall set *LCStream = CStream*. This action updates *LCStream* with the value of *Stream x* if the device accepts a HIMD, i.e. *LCStream* records the last Stream that was of interest to the device.

ACK(CStream, NumP=0) - If the host receives an ACK TP with NumP = 0, it shall transition to the **Idle** state, exiting the HOMDSM. This transition occurs when device has no more Function Buffer space available for the Stream, e.g. it is terminating the Move Data operation because the last DP exhausted its Function Buffer space. The host shall set *LCStream = CStream*. This action updates *LCStream* with the value of *Stream x* if the device accepts a HIMD, i.e. *LCStream* records the last Stream that was of interest to the device.

NRDY(CStream) - If the host receives an NRDY, it shall transition to the **Idle** state, exiting the HOMDSM. This transition may occur upon initial entry into the HOMDSM when the device rejects a HIMD, or during a Stream transfer due to unexpected internal device conditions where it wants to flow control *CStream*.

DPH(Deferred) - If the host receives a DPH with the Deferred (DF) flag set, then it shall transition to the **Idle** state, exiting the HOMDSM. This packet may be received when the link has transitioned to a U1 or U2 state and the host has attempted a HIMD or

between bursts on the OUT pipe, if there is a lot of endpoint activity on other devices and the Ux Timeouts in the path to this device are set to short values. When this transition occurs the host will wait in the **Idle** state for an ERDY from the device to restart the stream. There is no DPP associated with a deferred DPH.

ERDY() - If an ERDY is received, a race condition has occurred. During this condition, the device is in the **Start Stream** state and the host is in the **Move Data** state. The host has entered the **Move Data** state as the result of a HIMD, at the same time that the device has attempted to initiate a Stream transfer, and their respective messages have passed each other on the link. To resolve this condition, the host shall remain in the **OUTMvData Device** state and wait for an ACK or an NRDY from the device.

8.12.1.4.5.8 OUTMvData Host

In this state the host has received an ACK TP from a device and the device has more Function Buffer space available for *CStream*. The host responds with a DP containing Endpoint Data associated with the Stream. The pipe will also wait in this state between bursts from the host.

DP(CStream, PP=1) - If more Endpoint Data is available for the Stream and the host is continuing the current burst to the device, then the host shall generate a DP with PP = 1, and transition to the **OUTMvData Device** state. The DPP shall contain a *CStream* data payload. If the Rty flag was set in the last ACK from the device, then the host shall resend the appropriate DP. The host shall continue the **OUTMvData Host** to **OUTMvData Device** loop until all retries are exhausted or a good packet is received by the device.

DP(CStream, PP=0) - If the Endpoint Data available for the Stream is exhausted by transmitting this DP, then the host shall generate a DP with PP = 0, and transition to the **OUTMvData Host Terminate** state. The DPP shall contain a *CStream* data payload. This transition informs the device the host has exhausted its Endpoint Data for the Stream.

8.12.1.4.5.9 OUTMvData Host Terminate

In this state the host has just exhausted the Endpoint Data that it has available for *CStream* and sent the last DP for the Stream. The host is waiting for an acknowledgement for the last DP of the Stream.

ACK(CStream, NumP=0) - If the host receives and ACK TP with NumP = 0 and Rty = 0, then the host shall transition to the **Idle** state, exiting the HOMDSM. This transition occurs when both the host and the device have exhausted their respective Endpoint Data and Function Buffer space at the same time.

ACK(CStream, NumP>0, No Rty) - If the host receives an ACK TP with NumP > 0, PP = 0, and Rty = 0, then the host shall transition to the **Idle** state, exiting the HOMDSM. This transition occurs when the host has exhausted its Endpoint Data for the *CStream*, but the device still has more Function Buffer space available.

ACK(CStream, NumP>0, Rty) – If the host receives an ACK TP with NumP > 0 and Rty = 1, then the host shall transition the **OUTMvData Host** state and resend the appropriate DP. This transition occurs when the last packet received by the device was bad, and a Retry is required. The host shall continue the **OUTMvData Host Terminate** to **OUTMvData Host** loop until all retries are exhausted or a good packet is received by the device.

NRDY(CStream) - If the host receives an NRDY, it shall transition to the **Idle** state, exiting the HOMDSM. This transition may occur during a Stream transfer due to unexpected internal device conditions where it wants to flow control *CStream*.

DPH(Deferred) - If a DPH with the Deferred (DF) flag set is received, then the host shall transition to the **Idle** state, exiting the HOMDSM. This packet is received when the link had transitioned to the U1 or U2 state before the last DP was sent by the host. There is no DPP associated with a deferred DPH.